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The ECB Unconventional Monetary Policies and Borrowing Costs

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Resumo

O principal objetivo desta dissertação passa por estudar terórica e empiricamente o impacto das medidas não convencionais adoptadas pelo Banco Central Europeu nos custos de financiamento dos bancos e dos países. Assim, verificou-se qual o impacto dos programmas de compra de ativos pelo BCE nos yields das obrigações garantidas por créditos (*asset securitization bonds*), obrigações hipotecárias (*covered bonds*) e obrigações soberanas (*sovereign bonds*). Adicionalmente, foi analisado o impacto de algumas medidas execionais de provisão de liquidez nas taxas referidas.

A amostra utilizada consistiu em 23.425 obrigações, emitidas entre 1 de Janeiro de 2000 e 31 de Dezembro de 2016, com a seguinte distribuição: 1.477 obrigações garantidas por créditos, 12.989 obrigações hipotecárias e 8.959 obrigações soberanas.

Concluiu-se que apenas o programa de compra de obrigações do setor público teve impacto nos yields das obrigações garantidas por créditos. Contrariamente ao esperado, este programa contribuiu para o aumento destas taxas. O primeiro (CBPP1) e o terceiro (CBPP3) programas de compra de obrigações hipotecárias contribuiram para a diminuição dos yields destas obrigações. Adicionalmente, os resultados demostram que o programa de compra de obrigações do setor publico, bem como os programas (CBPP1) e (CBPP3) , provocaram uma redução nos yields das obrigações soberanas.

Palavras-chave: yields; obrigações emitidas por créditos; obrigações hipotecárias; obrigações soberanas; politicas monetárias convencionais e não convencionais; quantitative easing.

Abstract

This dissertation aims to theoretically and empirically analyse the impact of unconventional monetary policies adopted by the ECB on the borrowing costs of banks and governments. We analyse the impact of the securities market programme, asset-backed securities purchase programme, covered bond purchase programmes 1, 2 and 3 and public sector purchase programme on the bond yields. Moreover, we also analyse the impact of some ECB exceptional liquidity provision measures.

The base sample used on the empirical analysis consists on 23,525 bonds issued between January 1, 2000 and December 31, 2016, of which 1,477 are asset securitization bonds, 12,989 are covered bonds; and 8,959 are sovereign bonds.

We conclude that only public sector purchase programme impacted significantly on asset securitization bonds. Contrary to we expected, this programme contributed to an increase of bond yields. Besides that, the covered bond purchase programmes 1 and 3 lead to a significant decrease of covered bond yields. Aditionally, the results show that the public-sector purchase programme and the covered bond purchase programmes 1 and 3 have a significant negative impact on sovereign bonds yields.

Keywords: yield to maturity, asset securitization bonds; covered bonds; sovereign bonds; conventional and unconventional monetary policies; quantitative easing.

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1. Introduction

The main goal of this research project is to answer the following question: "How unconventional monetary policies adopted by the European Central Bank affects banks and governments borrowing costs?". Also, there are some secondary goals, namely:

- Explain the meaning of unconventional monetary policies and quantitative easing mechanisms and their relationship with both the 2007/2008 financial crisis and the subsequently sovereign debt crisis;
- Highlight the differences between the context and measures adopted by the United States Federal Reserve (Fed) vis-à-vis the European Central Bank (ECB);
- Describe the main measures adopted by the ECB over time;
- Explain the banking and sovereign risk relationship;

Looking back at the years before the 2007/2008 financial crisis in the United States, we can see a process of financial liberalization and innovation that contributed significantly to the increase of the overall productivity of economies. Additionally, the securitization of loans played an important role in bank´s diversification and risk management. However, U.S. securitization transactions were implemented in a way that banks and non-banks were able not only to sell loans, but also to take them off-balance sheet as soon as they had been granted. This led to weak underwriting standards and a lack of incentives for lenders to prudently lend only to who has capacity to pay. In mid-2007 the turmoil erupted and the bankruptcy of Lehman Brothers triggered the financial panic of 2008. Regarding that, bankers were so scared that they were afraid to take each other's credit risk, even overnight. The interbank market almost stopped, and spreads for interbank loans increased dramatically relative to similar maturity treasury

bills, so this sharp reflected a failing banking system (Putnam, 2013). A large number of financial institutions collapsed or were bailed out by governments during the global financial crisis that is commonly viewed as the worst financial crisis since the Great Depression of the 1930s (Trichet,2009).

Between May 2007 and March 2009, more than 3 trillion euros were erased from the market capitalisation of banks in Europe and the United States. The impact on the real economy triggered by the problems in the banking sector was extremely severe, producing record levels of unemployment and giving way to what is now referred as the "Great Recession" (Gerba and Macchiarelli, 2016).

The financial crisis deteriorated economic prospects, increased the cost of funding for banks, decreased commodity prices, increased risk aversion and massive financial stress have raised the worries of a sharp increase of fiscal deficit and government debt across Europe (Matei and Cheptea, 2013). In Europe after bailing out the banks, there was a reduction in governments tax revenue and more costs, so government budget deficits consequently expanded and occurred a sovereign debt crisis.

The use of unconventional monetary policies was explained as an important mechanism to deal with the financial crisis firstly and a few years later to deal with sovereign debt crisis. However, as the as the unconventional monetary policies adopted by ECB didn't solve immediately the sovereign debt crisis, a more aggressive expanded assets purchase programme was implemented in 2015 (van Lerven, 2016).

In this thesis is performed a regression analyses of the impact of ECB asset purchase programmes and exceptional liquidity provisions on European Union banks cost of borrowing as well as on countries cost of funding using a sample of 23,525 bonds issued between January 1, 2000 and December 31, 2016. We use three types of bonds: asset securitization bonds – 1,477 observations; covered bonds – 12,989 observations; and sovereign bonds – 8,959 observations.

From univariate analyses, it is possible to conclude that for asset securitization bonds the asset purchase programmes implemented by ECB didn't have any impact on banks' cost of borrowing, with the exception of the public-sector purchase programme, for which we find, contrary to what we expected, a significant positive impact on banks' yields. Our results also show that the three-year long term refinancing operations contributed for the decrease of this type of bond yields. Moreover, for covered bonds, the covered bond purchase programmes 1 and 3 reduced significantly bond yields. On the other hand, the securities market programme, the second covered bond purchase programme and the corporate sector purchase programme contributed significantly for its increase. Regarding the exceptional liquidity provision measures, the targeted and three-year long term refinancing operations contributed for the decrease of covered bond yields. Finally, for sovereign bonds, we show that the public-sector purchase programme and the covered bond purchase programmes 1 and 3 helped to decrease bond yields. Contrary, the securities market programme and the second covered bond purchase programme, contributed for its increase. For this type of bonds, the targeted and three-year long term refinancing operations and the reduction of deposit rate to zero contributed to a decrease of sovereign bond yields.

This thesis contributes for the existing literature on several ways. First, it shows the impact of unconventional monetary policies adopted by the ECB on the yield to maturity of sovereign bonds, asset securitization bonds and covered bonds simultaneously. Second, it is focused on the impact of several asset purchase programmes, like the securities markets programme, assets-backed securities purchase programme, covered bonds purchase programme 1, 2 and 3 and public sector purchase programme. Third, as some of these programmes are very recent and some of them are still active, at least until the end of 2017, the literature analysing the impact of these programmes on bonds yields

contributions very scant. Fourth, we contribute to the study of asset securitization bond yield determinants, since there are a small number of studies on this field. It is shown that different asset purchase programmes affect different types of funding instruments and are differently affected by common pricing factors. Fifth, this thesis also contributes to a better comprehension of the relation between banking and sovereign risk, which is very important for governments because changes on sovereign risk can affect significantly the funding conditions of banks and banks bailouts deteriorate government funding. Additionally, it empathizes the effects of financial and sovereign debt crisis on bank's and sovereign yields. Finally, although the focus are the programmes mentioned above, it was also analysed the impact of the three-year long-term refinancing operations, the targeted longer-term refinancing operations, the cutting of deposit rate do zero, Draghi speech and corporate sector purchase programme on bond yields.

This work is organized as follows: On the next section, we present the literature review, where prior theoretical and empirical studies regarding unconventional monetary policies and quantitative easing are discussed. In section 3, we present the hypotheses and describe our sample. Section 4 provides univariate statistics about the variables in study. In section 5 the results of the regression analyses are presented and discussed. Finally, a conclusion summarizes the study.

2. Literature Review

2.1. The origin of Unconventional Monetary Policy

Conventional monetary policy appeared functional and were used by Fed and ECB until the start of the financial crisis in 2008, with the common goal of reaching low and stable inflation. As ECB was concerned about maintain a 2% inflation rate, Fed was worried with both inflation and unemployment. It consisted on defining an inflation targeting and is based on the impact of the interbank market short-term interest rate on market real interest rates (Thimann, 2016). This happens because central bank affecting interbank lending rate influence the level of reserves that banks hold in the system (Joyce *et al.*, 2012). So, Burke (2015) argues that a decrease in the interbank market rate means less bank deposits on central bank and thus an increase on banks' cash reserves. This, in turn, encourages bank lending to both households and companies, which increases investment and consequently inflation. Moreover, the well-functioning of the financial sector depends on the ability of banks to obtain liquidity through money markets. The central bank is thus seen as a lender of last resort whenever there is an overall lack of liquidity (Burke, 2015).

For conventional policies, the set of interest rates has been implemented using several macroeconomic signals and following Taylor rule[1] (Joyce *et al.*, 2012). Taylor proposed a monetary policy rule for how central banks should alter interest rates in response to changes in economic conditions as actual inflation and employment levels to achieve a target inflation level. The Taylor rule implies

[1] Taylor rule consists on a formula created by Taylor, an economist at Stanford University, in 1993. It is used in the management of interest rates and allows central banks to change the interest rates to achieve a target inflation and output level. For more information see, e.g., Taylor (1993); Coibion *et al.* (2010) and Bogdanova and Hofmann (2012).

that central banks aim at stabilising inflation around its target level and output around its potential (Bogdanova and Hofmann, 2012).

Joyce *et al.* (2012) point out that with the onset of the financial crisis there was a change in monetary policy. While conventional monetary policy allows for low and stable levels of inflation, it cannot prevent the appearance of asset market bubbles (Joyce *et al.*, 2012). Given financial crisis effects, Taylor rules would recommend, on average, negative nominal interest rates to an economy recovery. Nevertheless, at a negative level, decreasing the interest rates further is not possible, so any additional monetary stimulus should be undertaken only by resorting to unconventional monetary policy tools. So, the usual official rate could not be changed according to the Taylor's rule (Bogdanova and Hofmann, 2012). Additionally, according to Reinhart and Rogoff (2009) economies with failing banking systems are likely to undergo severe deleveraging in all sectors during and immediately after the crisis period. So, during this deleveraging process, interest rates largely do not affect consumers, local governments and corporations decision-making processes. Related to this, there were fears that banks were holding onto funds to improve their viability rather than lending to the private sector (Reinhart and Rogoff, 2009).

As conventional monetary policy was not having the desired impacts, central banks have changed to an unconventional monetary policy. Michaelis and Sebastian (2014) show that the first ways of unconventional monetary policy consist of massive expansion of central banks' balance sheets to influence interest rates other than the usual short-term official rates and inflation. The most used way of unconventional monetary policy in many countries has been quantitative easing (Michaelis and Sebastian, 2014). Quantitative easing (QE) was first used in Japan to deal with the bursting of a real estate bubble and the deflationary pressures that followed in the 1990s. So, with interest rates at their zero lower bound, the Bank of Japan started purchasing government securities from the

banking sector, increasing the level of banks' cash reserves held in the system. The main goal was to improve lending to the whole economy, helping the increase of asset prices and remove deflationary forces (Joyce *et al.,* 2012).

2.2 The definition of Quantitative Easing and its importance

According to Szczerbowicz (2015), central banks can purchase assets by disposal of the other central bank assets ("pure credit easing") or be a part of the central bank balance sheet expansion ("quantitative easing"). The quantitative easing (QE) purchases can either be of government debt (treasury bonds or bills) or of assets issued by the private sector, both banking or non-banking private sector (Joyce *et al.*, 2012). These operations are quantity-driven (purchase volume), one-directional (buy-side only) and involve ownership transfer of the assets to the central bank (Thimann, 2016). Similarly, for Joyce *et al.* (2012) quantitative easing consists in the use of the central bank's ability to create acceptable means of payment in unlimited quantity to buy assets.

Given that, there are no divergences between the definitions of quantitative easing by different authors since all are based on the same principles of asset purchases by central banks and consequent balance sheet expansion.

Joyce *et al.* (2012) point out that the primary goals of the Fed QE programmes have been: (*i*) ensure sufficient liquidity in the financial system; (*ii*) reduce lending rates; (*iii*) reduce financial market risk; and (*iv*) maintain market confidence. According to Putnam (2013), Fed QE 2 (November 2010 – June 2011) and QE3 (September 2012 – December 2013) programmes aimed not only to impact long-term interest rates, but also the macro-economic transmission

process from interest rates to real GDP growth, potential inflation and job creation.

There are some theories that assessed QE impacts and importance, like Eggertsson and Woodford (2003), Andre´s *et al*. (2004) and Curdia and Woodford (2011). According to Eggertsson and Woodford (2003), the private sector is considered as a single representative agent who has an infinite horizon, faces no credit restrictions and assets held by the government and by central bank are indistinguishable from their own assets. Considering this framework, QE has no impact on real economy. However, Eggertsson and Woodford (2003) result does not hold in cases where there are credit constraints, limited financial market participation or distortionary taxes. Contrary, Andre´s *et al*. (2004), presented a model with limited participation in financial markets and agents which reveal different preferences for government bonds. In such a model, purchases by the central banks do matter. In the same line of reasoning, Curdia and Woodford (2011) consider the impact of credit imperfections and heterogeneity and show that QE can't affect demand and output for the purchased or not purchased government bonds. They define government bonds as one period claims paying a safe rate identical to the rate set by the central banks and which optimally is the same rate paid on bank reserves. So, result is that reserves and government bonds become perfect substitutes. When the central bank purchases government bonds from banks it removes them from the banks' balance sheet and increases bank reserves. However, as reserves and government bonds are substitutes QE does nothing (Curdia and Woodford, 2011).

2.3. Main differences in Unconventional Monetary Policies around the world

Smaghi 2009 argues that despite QE has started in Japan other countries have used this mechanism, but with significant differences. While the Bank of England (BoE) has devastatingly bought U.K. government bonds from the non-bank private sector, the Federal Reserve (Fed) has bought not only U.S. government bonds but also large amounts of agency debt and mortgage-backed securities. The differences in application of QE by the Fed and the BoE are not significant, since the majority of the mortgage-backed securities are guaranteed by the U.S. agencies (Government National Mortgage Association (GNMA); Federal National Mortgage Association (FNMA) and Federal Home Loan Mortgage Corporation (FHLMC)), which are government-owned entities (Smaghi, 2009).

However, the measures implemented by both the Bank of Japan (BoJ) and the ECB differ significantly from those of the Fed and the BoE. According to Fawley and Neely (2013), this can be explained by the fact that bond markets play a relatively more important role than banks in the U.S. and the U.K. economies – countries with market-based financial systems –, while banks play a relatively more important role in continental Europe and Japan – countries with bank-based financial systems.

Putnam (2013) points out that in the 2007-2008 financial crisis, the U.S. banking system faced liquidity and solvency challenges and in the presence of system bankruptcy, the Fed used its balance sheet and served as a lender of last resort to prevent financial panics turning into a great depression. During financial crisis, the Fed started with its first quantitative easing programme (QE1 – December 2008 -March 2010), and most of the balance sheet expansion was realised in a very short period after September 2008. The main measures adopted were the purchase of over $1.3 trillion of troubled securities as loans and agency debt.

Purchases under QE1 were implemented in a matter of weeks and were all performed before the end of 2008. The QE1 did not involve the purchase of U.S. government bonds and was designed to support the entire economy. Thus, the programme focused on housing credit markets, which had been especially hard hit by the 2006-08 fall in U.S. real estate prices, sales, and construction. In QE2 (November 2010 – June 2011) there was a maturity extension of the programme and started the purchase of US treasury bonds and in QE3 (September 2012 – December 2013) there was purchase of more mortgaged-backed securities, while at the same time the emergency purchases during QE1 of troubled assets and special facility investments were cleaned-up (Putnam, 2013).

According Ross *et al.* (2015), QE adopted by Fed had two main goals, price stability and full employment, while in Europe the main goal was price stability. Europe was dealing with a different problem than the U.S.: Euro area countries were affected by the sovereign debt crisis that started with the downgrade in Greece on April 24, 2010 and spread to other member countries, which led to the fragmentation of the single financial market and resulted in important differences in credit conditions across the Eurozone countries (Beirne *et al.*, 2011). Beirne *et al.* (2011) point out that ECB and governments first took some conventional measures to deal with the impacts of financial crisis 2008 on banks that consisted on changing interest rates according to Taylor rule and also lend money to banks thought long-term refinancing operations. However, with the start of sovereign debt crisis the ECB implemented other unconventional measures as asset purchases.

According to Putnam (2013), ECB's bank lending approach was effective in solving bank liquidity issues but not solvency challenges and wasn't effective in solve sovereign debt crisis as it would have been if ECB started immediately with asset purchases. Furthermore, as ECB started with bank lending measures and only implemented asset purchases latter, the size of the balance sheets of the Fed

and the Bank of England tripled, while that of the ECB doubled (Gambacorta *et al.*, 2014).

The main ECB unconventional monetary policies can be grouped into two main categories (Szczerbowicz, 2015). The first group includes exceptional liquidity provisions: (i) the three-year long-term refinancing operations (3y LTRO); (ii) the fixed-rate full allotment procedure (FRFA); and (iii) the set of deposit rate to zero. In the second group the author includes the asset purchases: (i) securities markets programme (SMP); (ii) outright monetary transactions (OMT); and (iii) covered bond purchase programmes (CBPP1 and CBPP2). Describing the measures implemented by chronological order:

- In 2008 ECB started with LTROs for short maturities (6 months). This measure consists on injection of huge amounts of central bank reserves into the banking system. Given that, LTROs are loans from central banks to banks whereby securities are used as collateral that is returned by the lender (the ECB) to the borrowers (the banks) at the end of a defined term (Tempelman *et al.*, 2012). This measure had the goal of supporting the normalisation of the functioning of the European money market. It helped banks and governments deal with potential short-term liquidity issues and decrease money market yields and spreads (Szczerbowicz, 2015). Therefore, ECB introduced LTRO for 12 months in 2009 and 3y LTRO in 2011.
- In 2009 ECB introduced FRFA procedure. Usually, the open market operations were conducted using a variable-rate. Still, this measure allows banks to satisfy their liquidity needs based on a fixed (in advance) interest rate, instead of a variable rate. After the Lehman Brothers collapse, the ECB introduced the FRFA procedure for all open market operations and for the foreign liquidity swaps. Thus, the ECB stepped in as a lender of last resort (Burke, 2015). According

Szczerbowicz (2015), the main goal of FRFA was help banks access to liquidity and offset liquidity risk in the market. It helped banks decreasing its borrowing costs.

- In 2009, ECB started CBPP1 and a few years later in 2011 started CBPP2. Provided that, CBPP1 and 2 consisted in outright purchases by ECB, from primary and secondary market, of covered bonds that pretended to hold until maturity. The main goals of this programme were to contribute to the decline in banks long term rates, easing funding situations for credit institutions, enterprises and households and encouraging credit institutions to preserve and expand their lending to clients (Burke, 2015). In practice, it this programmes impacts covered bond yields and spreads.
- In 2010, under SMP, ECB decided to purchase government bonds on secondary market. To distinguish SMP from the U.S. QE and to ensure that the monetary policy is not affected, ECB compensated this purchases through sales of other bonds or money market instruments to keep the money supply unaffected. Its main goals were stabilizing the euro given the Greek sovereign debt in spring 2010 that generated a fire sale of some Eurozone government bonds. Correspondingly, it impacts sovereign bond yields and spreads (Eser and Schwaab, 2013).
- On July 5, 2012, ECB decided to settle deposit rate to zero. Regarding this measure, wanted to influence banks to lend to each other; i.e., boost the operation of the interbank money market. The markets expected a cut in the deposit rate on that day, however the decrease to zero was a surprise (Szczerbowicz, 2015).
- In 2012, ECB started OMT that as SMP consists on purchase of government bonds from secondary market. Nevertheless, both are different in numerous aspects. First is that the maximum maturity of

bonds purchased was set to 3 years on OMT. The second is that the government of the country from where ECB purchases bonds needs to be complied with an adjustment program. The third is that the ECB decided to forgot its seniority status with respect to private creditors. The fourth is that OMT doesn't have limits whereas SMP was "temporary" and "limited (Altavilla *et al.*, 2014). Considering OMT goals, it wanted to repair monetary policy transmission mechanism, restore homogeneous credit conditions in the Eurozone and reduce sovereign yields and spreads. Its main goal was to deal with problems caused by Spain (Szczerbowicz, 2015).

2.4. Potential Costs of Quantitative Easing

Joyce *et al.* (2012), argue that despite the relevance of QE in Europe, it has not solved the problem of slow recovery after the 2007-2008 financial crisis and the subsequent European sovereign debt crisis. The author also points out that the purchases of government bonds by the ECB are helping to contribute to unsustainable levels of government debt. For Putnam (2013) and Cline (2015), the main problem is that when recovery occurs central banks will face huge problems in reducing the level of its reserves injected in the economy to avoid high levels of inflation. Additionally, Tempelman *et al.* (2012), argue that sovereign debt purchases by the ECB originates a transfer of credit risk from capital market participants to European taxpayers, which means that political interference and monetary policy become related.

According to van Lerven (2016), QE increases the risk of bubbles in the financial markets by artificially increasing the price of financial assets. Moreover, van Lerven (2016) and Claeys and Leandro (2016) posit that QE has the problem

of increasing inequality. The financial assets that suffer a price increase caused by QE purchases are mainly owned by wealthiest households. It increases inequality because allows them to benefit from the price increase by selling the assets at a higher price while the not so wealth households doesn't even own the assets or own it in a smaller quantity (Claeys and Leandro, 2016). In addition, van Lerven (2016) shows that by limiting the number of safe assets in the financial markets, QE re-channels investment towards pre-existing housing assets making housing more expensive and less affordable for low income earners. So, it reinforces the same type of lending that led to the 2008 financial crisis.

Furthermore, Claeys and Leandro (2016) argue that there is a risk of financial instability, because monetary policy supports the economy by encouraging more risk-taking when risk-taking in the financial system is less than socially desirable. In line with Geraats (2008), Claeys and Leandro (2016) also point out that there are credibility risks for the ECB since inflation deviates significantly from "below but close to 2 percent" for a prolonged period of time. Thus, expectations might start to deviate as well, and companies and households might start making decisions concerning wages and prices with a different inflation anchor in mind.

Finally, Thimann (2016) argues that the low long-term interest rates in capital markets caused by QE implies significant challenges for saving. This happens because the prices for what he considers the two investments of the long-term savings – housing and healthcare – are high. So, given the low long-term interest rates in capital markets the savers face a big dilemma: they don't save and see purchasing power decline for housing and healthcare declining, or they compromise financial security and invest in highly volatile assets, such as equity, whose return is highly uncertain and possibly negative.

2.5. European sovereign debt crisis and Quantitative Easing

As mentioned by Gerba and Macchiarelli (2016), there was a rapid increase in private sector borrowing in the Eurozone that caused a substantial increase in spending in the run-up of the 2007-2008 financial crisis. Nevertheless, in after crisis, there was too much private debt and poor prospects for growth which made the private sector started sacrificing spending. Additionally, regulations and oversized balance sheets caused a banking sector aversion to expand its lending. Furthermore, van Lerven (2016) points out that after bailing out the banks after financial crisis in 2008, government expenditures increased and tax revenues declined, which lead to a significant government budget deficits expansion and consequently caused a sovereign debt crisis in Europe. Austerity in the public sector and deleveraging in the private sector meant that most Eurozone countries had extensive cuts in spending.

Given this scenario, the ECB became concerned that demand would continue to decline, which could result in a fall in prices since if there is no demand for new goods and services, manufacturers start reducing prices. A decrease in prices usually lead to diminished business profits and incomes and less spending. So, as the unconventional monetary policies adopted by ECB until now – 3y LTRO, FRFA, set of deposit rate to zero, SMP, OMT, CBPP1 and CBPP2 – didn't solve the sovereign debt crisis a new expanded asset purchase programme (EAPP) was implemented (van Lerven, 2016). The ECB's EAPP adds the purchase of public sector securities to the existing private sector asset purchase programmes. This consists of an asset backed securities purchase programme (ABSPP), a covered bond purchase programme (CBPP3), and a public sector purchase programme (PSPP) and, more recently, a corporate sector purchase programme (CSPP) (Demertzis and Wolff, 2016). Heam *et al.* (2015) identified

that EAPP improves the liquidity holdings of the banks and consequently decreases interest rates, which stimulates economic activity and investment in the Eurozone.

Regarding that, in March 2015 ECB joined other central banks in resorting to large-scale asset purchases, after having reduced its policy rates at negative levels since June 2014 (Altavilla *et al.*, 2015). ECB (2015) defines that EAPP main goal is "to have a positive impact on the economy's growth and to raise inflation, bringing it back to the desired level of lower than but close to 2%". The money created under EAPP is intended to be temporary and does not involve ECB directly financing any private or public expenditure. Regarding this, van Lerven (2016) posits thtat QE stimulates spending through a number of complex channels in an indirect way.

The ECB announced the start of EAPP in January 2015, however it started in March 2015 and consisted in monthly purchases of €60 billion of public and private securities, €44 billion of which was dedicated to purchases of government and national agency bonds under PSPP, CBPP3 and ABSPP. The purchases were planned to be carried out until September 2016, and in any case until the Governing Council of the ECB sees inflation stabilising at values consistent with its inflation target (Thimann, 2016). The main goal of the programme expressed by ECB President Mario Draghi is to do "whatever it takes" to bring the core consumer price index (CPI) back to a 2%-target. In fact, since the start of the programme inflation has had hard time to even cross 1%, so following the ECB's Governing Council meeting of 3 December 2015, it was announced that the EAPP would be extended in scope, time, and possibly in size.

Given that, ECB extended the programme and expanded the list of national agencies whose securities are eligible for the public-sector purchase programme (PSPP) as well as the list of eligible collateral to include securities issued by regional and local governments. The programme was extended by at least 6

months until March 2017. This would thus be in course until the end of March 2017 and if necessary until the Governing Council sees a sustained adjustment in inflation that is consistent with its goal. Additionally, in this extension of the programme the deposit rate was cut by 10 basis points (bps), to -0.30%. It has changed the issue purchase limit which was originally set at 25 percent, to 33 percent (Altavilla *et al.,* 2015).

Claeys and Leandro (2016) highlight that the original rules of the EAPP inhibited the purchases in countries in which public debt was small and in which no national agencies were identified as eligible for purchases. The goal of most of the changes was therefore to expand the universe of available debt securities that the ECB could purchase, in order to delay the point at which the programme would reach its limits in each euro-area country. Since the ECB decided to purchase bonds with yields above the deposit rate in order to avoid making a direct loss on the purchases, the measure of decreasing the deposit rate effectively increased the amount of debt securities eligible for purchase.

A second extension in scope, but not in duration was performed with the ECB's Governing Council Decision of 10 March 2016. So, ECB decided to cut the interest rate on the deposit facility by 10 bps to -0.40%, and to extend the monthly purchases under the asset purchase programme to €80 billion starting in April, with corporate bonds – corporate sector purchase programme (CSPP) – being the latest type of assets added to the list of securities to be purchased by the ECB (Demertzis and Wolff, 2016). This second extension is primarily targeted at investment-grade type of corporate bonds and the start date of their purchases has been set to July 8, 2016. As pointed out by Gerba and Macchiarelli (2016), with this further extension, the ECB is hoping that the programme does not become old-fashioned, at least in the near term, and that further liquidity injection will help market conditions normalize. Before this second extension the

ECB has purchased about €1 billion per month under the ABSPP, almost €10 billion under CBPP3, and €50 billion under the PSPP.

In conjunction with an extension of the programme, a new series of targeted longer-term refinancing operations (TLTRO II), each with a maturity of four years, has been launched, with the start date set in June 2016. When ECB deposit rate was cut below -0.2 it made banks want to reduce their exposure to the ECB to the minimum. In order to do that, instead of increasing their lending to households and businesses, banks would likely move money to non-euro zone central banks. To avoid such scenario and get banks to lend more, the ECB decided to use a TLTRO (Gerba and Macchiarelli, 2016).

In December 8, 2016 the ECB - ECB extension report - announced another extension to the programme (ECB, 2017). The horizon of purchases under the EAPP was extended until the end of December 2017, or beyond, if necessary. The value of monthly purchases should continue to amount to €80 billion until the end of March 2017. From April 2017, the combined monthly purchases should start to be €60 billion until the end of December 2017. Finally, purchases of nominal asset-backed securities (ABS) with a negative yield to maturity below the deposit facility rate become permitted to the extent necessary.

Finally, on the following topics each of the programmes under EAPP will be explained with more detail.

2.5.1. Asset-backed Securities Purchase Programme

ABS consist on banks securitize their loans by selling them to a special purpose vehicle (SPV) which then issue bonds; i.e., loans are pooled together, with their cash flows, and converted into securities to be placed in the ECB's balance sheet (Blattner, *et al.*, 2016)

The ABSPP[2] was announced by the ECB in September 04, 2014 and started November 21, 2014, with the goal of lasting at least 2 years (Ross *et al.*, 2015). Under this programme, the ECB purchases ABS from financial sector. Senior and guaranteed mezzanine tranches of ABS will be purchased in both primary and secondary markets (ECB, 2014). According to ECB (2014) the main goals of the ABSPP are: (i) improve the transmission of monetary policy; (ii) facilitate credit provision to the euro area economy; (iii) generate positive effects to other markets; (iv) contributing to a return of inflation rates to levels closer to 2%; and (v) help banks providing credit to the real economy.

2.5.2. Covered Bond Purchase Programmes

According to Ross *et al.*, (2015) the CBPP3 main goal is to reduce banks long-term financing costs. The programme was announced on September 9, 2014 and implemented on October 20, 2014.

The CBPP consists on purchasing covered bonds issued by banks or mortgage agencies. According to the ECB (2008), 'covered bonds are dual-recourse bonds, with a claim on both the issuer and a cover pool of high-quality collateral (which the issuer is required to maintain), issued under specific covered bond legislation (or contracts which emulate this)'.

Given that, in case of failure of the issuer, the ECB can cover claims at any point of time. A key difference between the CBPP3 and the previous covered bond purchase programmes is that the third programme has no limit on its potential size. The programme was designed to last at least two years, compared with the one-year length of CBPP1 and CBPP2, and under which the ECB can purchase retained bonds directly from issuers, unlike the first two programmes.

[2] For further details about ABS see, e.g., Altunbas *et al.* (2009), Cardone-Riportella *et al.* (2010) and Schwarcz (2011).

On CBPP1 the purchases were limited by eligible covered bonds with a targeted nominal amount of EUR 60 billion and on CBPP2 there was a limit of 16.4 billion of euros (ECB, 2014).

2.5.3. Public Sector Purchase Programme

The purchases under the PSPP consist of bonds from euro area governments, securities from European institutions and national agencies. The main goal of PSPP is to decrease government bond yields. (Ross et al. 2015).

The programme was announced in January 1, 2015 and started on March 9, 2015. At the beginning of EAPP Eurosystem spent €50 billion per month in the PSPP, and the remaining €10 billion were split between ABSPP and CBPP3. The €50 billion per month to the PSPP was allocated such that 12% (roughly €6 billion per month) went towards the debt of supranational institutions. The remaining €44 billion purchased sovereign debt securities (ECB 2015).

2.5.4. Corporate Sector Purchase Programme

The CSPP was announced in March 10, 2016 by the ECB and began on June 8, 2016. Under this programme the ECB will purchase securities issued by non-bank companies in primary and secondary markets. Along with government-bond buying and ultra-cheap long-term loans, therefore, with this programme the ECB aims to reignite the Eurozone economy and raise the inflation rate to the target (ECB, 2017). The ECB has not revealed how much corporate debt it will buy. The central banks of Belgium, Germany, Spain, France, Italy and Finland are purchasing the corporate bonds on behalf of the ECB. Between the start of CSPP purchases on June 8, 2016 and July 15, 2016, the ECB bought €10.4 billion of non-

bank corporate bonds, of which 7% were made in the primary market and 93% in the secondary market (ECB, 2016)[3].

2.6. Expanded Asset Purchase Programme channels of transmission

There are some authors [e.g.: Ross *et al.* (2015), Gerba and Macchiarelli (2016), van Lerven (2016)] that implemented seminar assessments of the impact of the ECB's EAPP. Although the EAPP is recent, it is important to analyse whether it is having the desired effects. To do so, some authors [e.g.: Heam *et al.* (2015), Altavilla *et al.* (2015), Blattner *et al.* (2016), Albertazzi *et al.* (2016), van Lerven (2016)] consider that is important to consider the efficiency of the different transmission channels independently, while other authors [e.g.: Altavilla *et al.* (2015), Andrade *et al.* (2016), Hofmann *et al.* (2016), Gibson *et al.* (2016)] focus on the analysis of the impact on bank financing costs, sovereign bond yields and corporate bond yields. Taking all the studies together, there are divergences between the results regarding the assessment of the transmission channels.

Will be explained next the meaning of some transmission channels (inflation and expectations/signalling channel; rebalancing channel; bank lending channel and exports channel) and its impacts.

Considering the meaning of inflation for Khan and Gill (2010) and Coibion, *et al.* (2010) an inflation increase means that the general level of prices for goods and services increases, so purchasing power of savings deteriorates. Moreover, it also leads to a contraction in economic growth and increase in macroeconomic

[3] For more information about Corporate Sector Purchase Programme impacts see, e.g., European Central Bank (2016) and Abidi *et al.* (2017).

instability. Additionally, Coibion *et al.* (2010) considers that the 2% goal for inflation in Europe is important because preserves the purchasing power, leads to stable long-term interest rates and reduces distortions of tax and social security systems. Furthermore, Cova *et al.* (2015) and Conti *et al.* (2017) analysed how ECB purchases impacts inflation in Europe and found a positive relationship. Regrading EAPP impact on inflation van Lerven (2016) observed the inflation behaviour after the beginning of the programme and considers that there that there isn't any effect. He also believes that there is good reason to believe that oil prices may be distorting EAPP effect on prices, but even excluding oil prices, on average core inflation in the 12 months before the programme began was 0.8% and since the programme was implemented, it has continued to average 0.8%

It's possible that EAPP impact inflation through the signalling channel, according to Altavilla *et al.* (2015) and Albertazzi *et al.* (2016) buying considerable amounts of long-term securities ECB shows the market that the is committed to keeping interest rates low well into the future and consequently low inflation. Regarding this, expectations about future inflation are important for investors actual investment decisions and determines current inflation (van Lerven 2016). According the survey of professional forecasts only the 5-year ahead inflation expectation comes somewhere close to the 2 percent target (Gerba and Macchiarelli, 2016).

Defining the rebalancing channel Albertazzi *et al.* (2016) affirmed that purchase programmes exercise pressure to an increase of the supply of credit to the riskier segments of the economy. It happens because by reducing yields on safe long-term securities, investors have incentives to shift their investments to assets with higher expected returns, consequently taking on more risk. According Blattner *et al.* (2016) information, the portfolio rebalancing that is induced by the ECB purchases increases the price of EAPP-eligible securities. So, this leads to a valuation gain for the banks that hold eligible securities on their

balance sheets because if banks sell these assets, they will realize a valuation gain from the price increased. Provided that, banks will have more money available to lend to riskier investors. By contrast, for Albertazzi *et al.* (2016) portfolio rebalancing caused by EAPP is statistically significant only for asset holders residing in more vulnerable countries, where credit conditions are still comparatively tight. For them, portfolio rebalancing caused an increase in risk-taking in vulnerable economies. However, when looking at lending volumes granted by banks, they obtained evidence of limited effects to non-vulnerable countries.

Let's now consider the bank lending channel, Gerba and Macchiarelli (2016) define that when central bank purchases assets injects new central bank reserves into the banking system which leaves banks with less balance sheets constraints and decrease its borrowing costs. The EAPP was created to push banks to sell their holdings of government debt and take on more risk, either by focusing on other asset classes or lending more to households and firms. Given the study of Cline (2015) this channel is based on the theory of the money multiplier which suggests that banks require new reserves before they make new loans. So, if there are no private needs for loans the bank lending to private sector will not increase. His results in the euro area shows that loans to household increased 1.5 percent in April 2016, but it went down from a 1.6 percent rise in the previous couple of months. Also, the credit to non-financial corporations grew 1.2 percent, higher than a 1.1 percent rise in March. But, credit to governments also increased (Cline 2015). According to van Lerven consumer lending in January 2016 increased by 1.4% and business lending declined by 0.55% (van Lerven, 2016).

Looking for the exports channel, van Lerven (2016) defends that EAPP causes an increase in exports by devaluating the currency and influencing yields and interest rates. Lower yields on bonds make them less attractive to investors and as yields fall on assets priced in euros, investors will prefer foreign assets offering

higher yields. So, this requires them to exchange euros for foreign currency to buy these kind of assets, which causes capital outflows and a devaluation of euro. A devalued currency may then have positive effects on the economy by making exports cheaper and imports more expensive which increases inflation. By contrast, Heam *et al.* (2015) argue that the announcement of the exact value of the purchases in January 2015 allowed the markets to fully integrate this information into the exchange rates, which subsequently stabilised. Paradoxically, was when the programme finally came into force on March 2015 that the Euro exchange rate stabilised (see Figure 1). All in all, the decline in interest rates caused by EAPP combined with the depreciation of the Euro observed thus far appears to have strengthened economic activity in 2015.

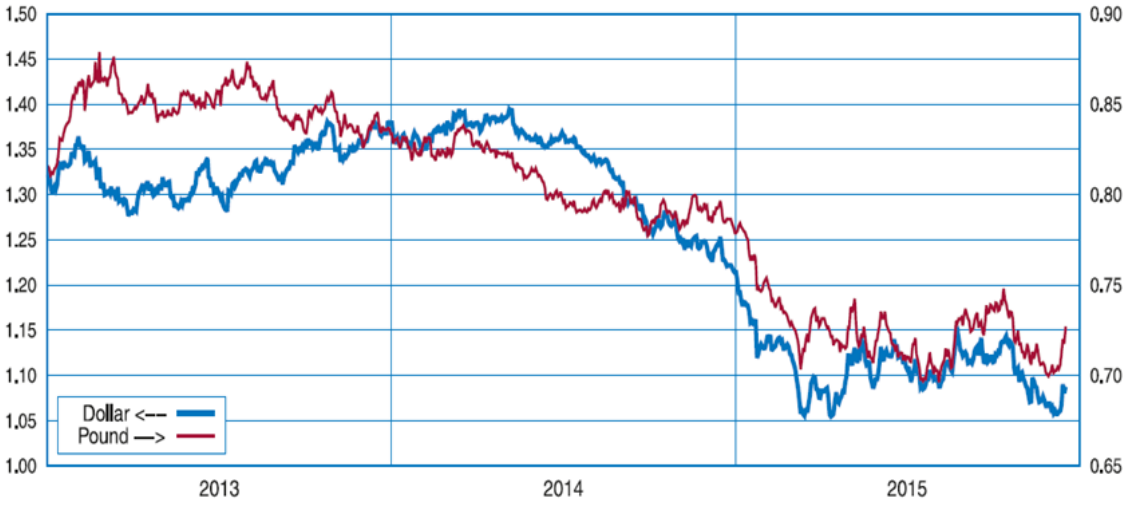

Figure 1: Euro exchange rates. Source: Thomson Reuters

2.7. The relationship between bank risk and sovereign risk

Fontana and Scheicher (2010) argue that the collapse of Lehman Brothers in September 2008 caused a need for several EU governments to adopt financial sector rescue packages of unprecedented size. The government guarantees

provided to banks resulted in significant fiscal burdens which in turn increased the risk of sovereign default. The financial crisis was centred on the banking sector, so banking and sovereign risks became interconnected. Similarly, Dieckmann and Plank (2012) show that an increase in the cost of sovereign debt leads to a price decrease, which damages the balance sheets of banks that hold these assets. Gerlach, *et al.* (2010) also investigate the relationship between sovereign and bank risks and conclude that aggregate risk factor, structure and size of national banking sectors are the major determinants of sovereign bond spreads. In times of aggregate risk increasing, governments with larger banking sectors experience a rise on risk and consequently on spreads. They also conclude that, sovereign spreads decrease with the increase of bank's equity ratio; i.e., governments should require banks to hold more equity to reduce aggregate risk. Moreover, Alter and Schüler (2012) also studied the bank sovereign risk relationship using daily credit default swap (CDS) data during the 2007 to 2010 period. They conclude that first before bailouts, the increase in countries default risk has its origin in financial sector; and second after the financial crisis, banking sector default risk became strongly influenced by sovereign risk, increasing the sensitivity of sovereign risk because of shocks in the financial sector.

Zaghini and Levy (2010) examine the effects of the government guarantee schemes for bank bonds adopted in the aftermath of the Lehman Brothers' bankruptcy using samples of more than 500 bond issues they find that sovereign guarantor characteristics is the most important factor that influences bank spreads, whereas bank-specific factors as credit risk and issue specific factors as volume and maturity play only a minor role. They conclude that "weak" banks from "strong" countries may have had access to cheaper funding than "strong" banks from "weak" countries (Zaghini and Levy, 2010). In 2014, Zaghini concludes that countries with Triple A Rating provided a safety net to their home banking system, while countries without it could not give that implicit support

increasing the funding costs of banks. The author also find that the link between sovereign and banking risk is particularly significant in crisis periods (Zaghini, 2014).

Acharya *et al.* (2014) study the relation between sovereign and bank risk using CDS rates on European Countries and banks between 2007 and 2011 and find that: (i) bailouts caused the rise of sovereign credit risk; and (ii) after that changes on sovereign CDS explain significantly changes on banks CDS.

Szczerbowicz (2015) employed some event-based regressions to measure the impact of ECB asset purchases on sovereign and covered bonds spreads. The existent programmes with goal of influence sovereign bonds are SMP and OMT. In the regression of the impact of the programmes on sovereign bonds was used daily data from 2007 until 2012 and analysed a total of 1,368 observations. The existent programmes with goal of influence bank covered bond spreads and yields are CBPP1 and 2. In the regression of the impact of the programmes on covered bonds was used daily data from July 2, 2007 until September 27, 2012 and a sample of 1,368 covered bonds. Szczerbowicz (2015) verified the bank and sovereign risk relationship in Europe looking for the impact of ECB programmes designed to decrease bank funding costs (CBPP1 and 2) on sovereign bonds and similarly looking for the impact of programmes designed to decrease sovereign funding costs (SMP and OMT) on covered bonds. The results showed that SMP and OMT have a superior impact on covered bond spreads than covered bond purchases themselves.

2.8. The impact of Quantitative Easing on Banks and Governments Borrowing Costs

2.8.1. Sovereign Bonds

For QE in U.S. Gagnon *et al.* (2011) performed an event study of Fed large-scale asset purchases (LSAP) communications effects on interest rates (two-year and ten-year treasury yields, ten-year agency debt yield, current-coupon thirty-year agency MBS (mortgage-backed securities) yield, ten-year treasury term premium, ten-year swap rate, and the Baa corporate bond index yield) using a total of 280 observations. They concluded that the Fed's purchases between December 2008 and March 2010 regarding LSAP1 had economically significant and long-lasting effects on longer term sovereign bond interest rates. Using both event studies and time series regressions relating risk premium to measures of the supply of government debt, the authors estimated that the LSAPs reduced the 10-year sovereign bond yields by somewhere between 30 and 100 bps overall. There are some studies that have also found that the Fed's LSAP1 asset purchases were successful in reducing medium and long-term interest rates, including those by Neely (2010) and Hamilton and Wu (2011).

Neely (2010) performed an event study to evaluate the effect of Fed's 2008-09 QE on international long bond yields and exchange rates. To account for sample variation in estimation they bootstrapped 1,000 samples of 303 observations. The results show that the announcements decrease treasury yields. Furthermore, Hamilton and Wu (2011) indirectly calculate the effects of the Fed's 2008-09 QE programmes with a term structure model. The sample was constituted by 917 observations of weekly observations for constant-maturity treasury yields. They used model of risk-averse arbitrageurs to develop measures of how the maturity

structure of debt held by the public might affect the pricing of level, slope and curvature term-structure risk.

For U.K. , Joyce *et al.* (2011) found that the first round of the BoE's asset purchases had economically significant effects on gilt yields. It was estimated that medium-to long-term gilt yields fell by 100 bps overall, summing up the two-day reactions to the first round of the announcements on QE purchases during 2009–10. Although the precise estimates differ across studies, there is a broad consensus in the literature that central bank asset purchases had economically significant effects, at least on government bond yields (Joyce *et al.,* 2012).

Additionally, for european countries Eser and Schwaab (2013) assessed the impact of asset purchases within the ECB SMP in five euro area sovereign bond markets (Italy, Ireland, Spain, Portugal and Greece) during 2010 to 2011 period. They showed that government bond purchases undertaken within the SMP were effective in affecting yields even despite the context of the severe sovereign debt crisis. Regarding announcement effects, they find that the repeated interventions had an impact ranging from approximately -1 to -2 bps in Italy and up to -17 to -21 bps in Greece at the five-year maturity per 1 billion of bond purchases. The remaining impact estimates take intermediate values. The cross-country differences in yield impact can be explained by different market sizes and default risk. They found evidence for the long run impact being on average approximately three quarters of the immediate impact. Also, Gibson *et al.* (2016) performed an event study using monthly to cover the period from 2004 through 2014. They measured the impact of SMP on sovereign bond spreads for Greece, Ireland, Italy, Portugal, and Spain and found that SMP decreased sovereign bond spreads in a small but significant way.

Similarly, Altavilla *et al.* (2014) analysed OMT announcements impact on government bond yields for 5 countries (Italy, Spain, Germany and France). The model is estimated over the sample period 1999Q1–2012Q3. It was used high-

frequency data and found that OMT announcements decreased the Italian and Spanish 2-year government bond yields, while leaving unchanged the bond yields of the same maturity in Germany and France.

The studier Szczerbowicz (2015) employed event-based regressions to measure the impact of ECB asset purchases and liquidity provision on sovereign bond spreads in Eurozone and some European countries (France, Greece, Ireland, Italy, Portugal, and Spain). The existent programmes with goal of influence sovereign bonds are SMP and OMT. Was used daily data from 2007 until 2012 and analysed a total of 1,368 observations. Regarding this, in the Eurozone level the strongest impact was the impact of SMP, which reduced the spreads by 16 bps. The effect is even stronger for the countries with more sovereign risk as in Greece, in Ireland and Portugal. In Italy and Spain there was a smaller impact while French spread does not react. Also, OMT, had a similar impact on the benchmark euro-zone sovereign spread of −14 bps. OMT programme was announced in a context of sovereign debt crisis in Spain, and the response of this programme in this country was the strongest, a decrease of 59 bps. The decrease on the Italian and Portuguese spreads was also significant and a little less significant for Irish spreads and was not significant for the Greek spread. The French spread reacted but only decreased 7 bps. The programmes CBPP1 and CBPP2 reduced the sovereign spreads 5 bps in Eurozone and are particularly important in periphery euro-zone countries (Szczerbowicz, 2015).

Altavilla *et al.* (2015) performed an event study (using a list of 17 announcements from ECB) to study EAPP impacts on sovereign bond yields for Eurozone in general and France, Germany, Italy and Spain. The temporal horizon was from 2014 to 2015. They predicted the effects of EAPP announcements as being of -20 bps for German yields, between -30 and -40 bps for French yields, and between -60 and -80 bps for Italian and Spanish yields. Long-term yields have declined sharply over the period when the debate on a possible purchase

programme by the ECB has intensified, so from the end of 2013 10–year government bond yields in European Union (EU) started to decline sharply until the end of March 2015, right after purchases began. The central countries sovereign yields declined and because of that investors have turned to the government debts of peripheral Eurozone countries and this makes their yields decrease even more.

In the same way of the previous studies, Heam *et al.* (2015) considered not only the base interest rate but also the size of central bank balance sheet. They estimate a monthly Vector Autoregression (VAR) model for the period from January 1999 to March 2015. German six-month and 1 to 15-year sovereign bond yields were considered as risk free rates and for shorter maturities was also used the European OverNight Index Average (EONIA) and the 3-month Euro interbank offered rate (Euribor). The variation in rates caused by EAPP in Eurozone taking all this into account can thus be characterised as a decrease of 80 bps in 10-year sovereign bond yields between July 2014 and January 2015, followed by a period of stability. Heam *et al.* (2015), although the ECB did not officially reveal its sovereign debt purchasing policy until January 2015, sovereign yields started to decline well before since 2014. Moreover, the effect of these asset purchases on sovereign bond rates is more significant since the start of public asset purchases by the ECB in massive quantities on the secondary market.

Furthermore, Andrade *et al.* (2016) performed an event study of the effects on bond yields of the announcement of the PSPP on 22 January 2015 and at the beginning of its implementation on 9 March 2015. They focused on these dates because of the associated sizable changes in euro area sovereign bond yields. The sample used covers the period from 22 December 2014 to 12 April 2015 and were formed by 26,976 observations. They concluded that average yields dropped on average by about 13 bps after the announcement and an additional 14 bps after the implementation. This effect is more pronounced for medium duration

(between 5 and 10 years) and long duration (more or equal to 10 years). There were yield decreases on implementation day after 9 March, however all market-relevant information on the programme had been released previously, on 5 March. This happened due to the release of new information such as the exact maturity distribution of the purchases, which had not previously been announced (Andrade *et al.,* 2016).

2.8.2. Asset Securitization and Covered Bonds

Asset securitization bonds (AS) and covered bonds (CB) are defined as processes that put financial assets together, with their cash flows, and convert the assets into negotiable securities to be placed in the market. While in a traditional AS transaction the assets are transferred to a vehicle company created for this purpose through a sale, in a CB cover-pool assets remain in the issuer's balance sheet and investors have a priority claim against the collateral assets in case of default (Schwarcz 2011). Given that, CB have a dual nature of protection since they are backed by a pool of specific underlying assets such as high-grade mortgages or public sector debt in addition to the issuer's wealth. Thus, CB have associated a lower risk when compared with AS bonds [Schwarcz (2011), Szczerbowicz (2015)].

When markets began to look with doubt to AS instruments and at the same time when liquidity in the markets was rare European market for CB grew meaningfully, making it an important source of financing for the European banking system. As well, CB proved themselves relatively resilient during the 2007-2008 financial crisis, principally when compared with AS. Moreover, CB are subject to fitted regulatory control and preferred treatment under Basel III and Solvency II. Regarding this, there are several authors [e.g.: Lucas *et al.* (2008) ,Bernanke (2009), Carbo-Valverde *et al.* (2013)] defining CB as a good alternative

to AS. There are some recent studies that affirm that AS played an important role in letting financial institutions solving liquidity and funding difficulties in the post-crisis period, because it was an active tool to access various lending schemes by central banks. However, with the financial crisis several complex structured products like collateralized debt obligations (CDOs), synthetic CDOs and squared CDOs may have disappear forever [Altunbas *et al.* (2009), Cardone-Riportella *et al.* (2010)]. Its known that covered bond primary markets have experienced increases and decreases in the past years. Succeeding a year of record issuance in 2006, euro benchmark covered bond supply dropped in 2008 with the financial crisis and Lehman Brothers bankruptcy. However, the primary markets for covered bonds recovered impressively, and in 2011 euro benchmark issuance levels exceeded the 2006 record.

Given the financial and sovereign debt crisis and similarities between AS and CB the ECB relied on three CBPP (2009, 2011 and 2014) and ABSPP (2014) to restore bank funding, improve the transmission of monetary policy and providing further monetary policy accommodation.

There are many authors that study the AS bonds price determinants and the impact of the external factors as financial crisis, sovereign debt crisis and the unconventional measures adopted by ECB. However, in this thesis we will improve the previous studies by focus in analysing the impact of ECB programmes as ABSPP on AS bonds yield.

Analysing empirical studies for covered bonds, Beirne *et al.* (2011), used a sample period from 2007 to 2010 and studied the impact of CBPP1 on primary and secondary covered bond markets performing an event-study. For primary markets, they found that these programme leads to a substitution of uncovered bonds by covered bonds. For secondary markets, they analysed the impact of CBPP announcements on covered bond spreads and found that for most euro area covered bond markets, the results are consistent with a decrease of spreads

induced by the CBPP1. Also, Schuller (2013) performed an event-study of the impact of ECB measures on covered bond spreads and found that between the following programmes: CBPP1, SMP, CBPP2, LTRO's and OMT, the CBPP1 and the OMT announcement have been most effective, not only in terms of reducing spreads, but also as found by Beirne *et al.* (2011) by facilitating renewed access for banks to covered bond primary markets. However, OMT had the highest impact. Moreover, the author points out that the overall effect of CBPP2 in the spreads was a sharp difference between core Europe and distressed European countries, the effect of lowering covered bond spreads was higher for non-distressed countries. However, CBPP2 was probably one of the least effective ECB policy measures in recent years (Schuller, 2013).

Later, the studier Szczerbowicz (2015) employed event-based regressions to measure the impact of ECB asset purchases on bank financing costs looking to covered bond spreads in Eurozone and some European countries (France, Greece, Ireland, Italy, Portugal, and Spain). The existent programmes with goal of influence bank covered bond spreads are CBPP1 and 2. Was used daily data from July 2, 2007 until September 27, 2012 and a sample of 1,368 covered bonds. For Eurozone, the results show that SMP had the strongest impact and diminished the covered bond spread by 19 bps. They were followed by OMT which decreased covered bond spread on 6 bps, also CBPPs 1 and 2 caused a decrease of 4 bps on the spreads, and three-year LTROs caused a decrease of 4 bps. It is interesting to note that sovereign bond purchases (SMP and OMT) have a superior impact on covered bond spreads than covered bond purchases themselves. It shows that there is a relationship between bank and sovereign risk. Regarding the country level the impact of SMP and OMT was higher on Eurozone periphery. As expected, CBPP1 and CBPP2 diminished covered bond spreads in all countries studied, except for Ireland and Portugal and its impact was also higher on peripherical countries. Three-year LTROs reduced spreads in

France, Germany, Ireland, Italy, and in Spain. The FRFA procedure also contributed to spread reduction, particularly in Spain (Szczerbowicz, 2015).

Moreover, Gibson *et al.* (2016) performed an event study to investigate the relationship between CBPP1 and 2 with covered bond prices for Greece, Ireland, Italy, Portugal, and Spain using monthly data for 2004 to 2014. Regarding the impact of the CBPPs, they found that it was a small effect and caused a price increase of less than 1 per cent. The results suggest that cumulatively the impact considering a lagged dependent variable up to 3 lags (using a model ARMA (3,2)) could reach 15 per cent, but this is clearly a maximum effect. It is possible to interpret the price effect in terms of yields because a price increase means a yield decrease.

Also, Hofmann *et al.* (2016), using data from 2007 to 2015 for Germany, Spain, France, Ireland, Portugal and Italy used event studies, and considered daily data for interbank deposits and bond yields to establish the impact of policies using higher frequency data during a 3 to 5 days window. The main results from were that EAPP announcements had a positive impact on covered bond yields mainly on Ireland of 82.4 bps, CBPP 1, 2 and 3 announcements had a negative impact on Spain and Italy and ABSPP had a positive impact on Germany, Spain, France and Italy. After that confirmed the results using a Bayesian VAR with monthly data. Peripheral countries benefitted from liquidity operations, targeted lending and asset purchases, while core countries like France and Germany experienced less significant impacts particularly as funding costs approached the zero lower bound. Finally, Gürtler and Neelmeier (2016) study what factors influence risk premiums of public covered bonds, using a sample of 560 covered bonds from ten different countries and eight different currencies. Most existing studies either focus on mortgage covered bonds or do not investigate mortgage and public covered bonds separately. Thus, they fill a gap in the literature by explicitly investigating the public covered bond market. Their results show that while the

two crises had an increasing effect on covered bond spreads, for monetary policy measures by the ECB the effects are mixed. So, CBPP1 lowered risk premiums of public covered bonds. However, CBPP2 does not impact significantly public CB spreads.

3. Hypotheses and Sample Selection

3.1. Hypotheses

To examine the impact of the ECB's EAPP (CBPP1, CBPP2, CBPP3, ABSPP, PSPP and CSPP) on both sovereign and bank funding costs and the relationship between banking and sovereign funding conditions, we raised the following 5 hypotheses:

Hypothesis 1 [H1]: The ABSPP, by allowing banks to securitize their loans, increases available liquidity and thus reduces AS bond yield.
[e.g.: Ross *et al.* (2015), Blattner *et al.* (2016)]

Hypothesis 2 [H2]: CBPP1, CBPP2 and CBPP3 lead to a significant decrease on banks costs of funding by reducing covered bond yields.
[e.g.: Beirne *et al.* (2011), Schuller (2013), Szczerbowicz (2015), Hofmann *et al.* (2016), Gürtler and Neelmeier (2016)]

Hypothesis 3 [H3]: The PSPP have a significant negative impact on sovereign bonds cost of funding.
[e.g.: Szczerbowicz (2015), Heam *et al.* (2015), Andrade *et al.* (2016), Hofmann *et al.* (2016)]

Hypothesis 4 [H4]: The Securities Markets Programmes, SMP1 and SMP2, reduced significantly sovereign bond yields.
[e.g.: Zaghini and Levy (2010), Fontana and Scheicher (2010), Alter and Schüler (2012), Zaghini (2014), Szczerbowicz (2015)]

Hypothesis 5 [H5]: The impact of the asset purchase programmes and exceptional liquidity provision measures adopted by ECB is higher for peripherical European countries than for core countries.

[e.g.: Altavilla *et al.* (2014), Altavilla, *et al.* (2015) Szczerbowicz (2015), Hofmann *et al.* (2016)]

The five hypotheses raised will be tested in next section, in which both univariate and multivariate analysis will be implemented. The univariate analysis consists on an examination of descriptive statistics of microeconomic data (number of observations, mean, median and standard deviation) and performing some tests of significance for the difference in variables' values among the different deal types. The multivariate analysis consists on perform some regressions and interpret the results.

Regarding H1 to H4, will be conducted some regression analyses of the impact of asset purchase programmes (ABSPP, CBPP's, PSPP and SMP) on bond yields issued by European banks. Additionally, analysis will be conducted by creating sub-samples according to whether bonds are issued by banks located in Portugal, Italy, Ireland, Greece and Spain (PIIGS), Germany or non-Germany countries.

To test H5, in a first approach, we will base the analysis on the evolution of bond yields across time for each country by deal type. Then, when performing regressions analyses we will include variables allowing us to understand the differences between impacts on peripherical and central countries [e.g.: Altavilla *et al.* (2014), Altavilla *et al.* (2015) Szczerbowicz (2015), Hofmann *et al*. (2016)].

3.2. Sample Selection

Our sample consists of individual bond issues extracted from the DCM Analytics database. The DCM Analytics database is provided by Dealogic and provides information about public debt securities issued on the debt capital markets. This database contains complete historical information on virtually the entire population of bond securities issued in international capital markets and provides information on the micro features of the bond offers (e.g., transaction, tranche size, rating, maturity, currency, interest rate) and of the issuers (e.g., name, nationality, industry sector). To select the samples of AS, CB and SB issues, we extracted AS bonds and CB issued by banks between January 1, 2000 and December 31, 2016 and SB issued by governments on the same period.

The database extracted from DCM Analytics contains information on several types of bonds, however we only include those with a deal-type code of "asset-backed securities", "covered bond" and "sovereign bond". We include bond tranches classified either as fixed rate bonds (with coupon rate information) or variable rate bonds (with both spread and index information). We also require that the issuer country belongs to European Union and that the tranche size (in Euro millions) be available. Finally, in order to take possible outliers into account we winsorize the data for transaction size and credit spread at the 1% and the 99%.

After applying these screens, we arrived to our full sample that allow us to examine a total of 23,425 bonds (worth € 39,898.00 billion) issued by European Union banks located in 21[4] different countries. Our sample contains information

[4] Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Estonia, Ireland, Italy, Luxembourg, Netherlands, Lithuania, Portugal, Spain, Sweden, United Kingdom, Malta, Slovak Republic, Slovenia.

on 1,477 AS issues worth €21,142.60 billion, 12,989 CB issues worth €3,872.58 billion, and 8,959 SB issues worth €14,882.80 billion.

Data on macroeconomic variables, such has risk free rate, slope of the euro swap curve and volatility, was obtained from Datastream[5]. Also, GDP data was obtained from World Bank, and government debt from Eurostat. We linked the macroeconomic variables and the microeconomic information contained in DCM Analytics database on the issue date.

3.2.1. Description of Variables

The yield to maturity (yield) of the bond at issue, in basis points, is used as dependent variable in our regression models. It was also used as dependent variable on previous studies of Beirne *et al.* (2011), Gagnon *et al.* (2011a, 2011b), Schuller (2013), Heam *et al.* (2015), Altavilla *et al.* (2015) and Andrade *et al.* (2016). The yield includes the risk of the issuer because it incorporates the uncertainty associated with a potential loss on payment of either principle or interest on a fixed income obligation (Jacobs, 2010). So, the yield of a bond represents the total return that will be earned by an investor who purchases a bond and holds it until its maturity date. The alternative variable which could represent the investors return of a bond is its spread, however given our sample the use of the spread as dependent variable reduced the number of observations. In this thesis, we consider the following control variables as determinants of the yield:

- **Credit rating:** represents the rating assigned by a credit rating agency at the time of issuance, which describes the creditworthiness of the instrument. In this thesis is used a rating classification scheme based on 22 rating scales from S&P and Moody's. The rating is converted as

[5] DataStream is provided by Thomson Reuters.

follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=22 [Sorge and Gadanecz (2008), Vink and Thibeault (2008), Gatti *et al.* (2013)]. It means that, the higher the value the lower the credit rating. Furthermore, Sironi and Gabbi (2005), Zaghini (2014) and Zähres (2012) have studied the relationship between credit rating and credit spread and they found that the higher the credit risk, meaning a higher rating, the higher the credit spread. So, we expect a positive relationship among yield to maturity and credit rating for the three deal types in the study.

- **Time to maturity:** is the maturity of bonds, in years. Bonds with longer maturities tend to be riskier than loans or bonds with shorter maturities because predictability of future cash flows decreases with time. Consequently, investors usually demand higher premium for longer term securities. Empirical results show that lenders get a higher remuneration for being exposed to risk for a longer period of time [Sorge and Gadanecz (2008), Gerlach *et al.* (2010) Gürtler and Neelmeier (2016)]. Gerlach *et al.* (2010) performed an empirical study about the impact of unconventional monetary policies on sovereign bond spreads using time to maturity of bonds as a control variable and found that in some of the regressions performed it has a positive impact. However, in other regressions performed on the same study the impact was insignificant. For covered bonds spread, Gürtler and Neelmeier (2016) found that maturity has a positive impact. Also, Sorge and Gadanecz (2008) show that credit spreads for both investment-grade and speculative-grade bonds are a positive linear function of maturity. Regarding securitization bonds, Vink and Thibeault (2008) found a significant negative relationship between spread and MBS maturity. However, the coefficients on ABS with low maturity and high maturity

are insignificant. Thus, the variable expected on AS bonds spread sign cannot be determined clearly from the empirical literature.

- **Number of banks:** represents the number of banks supporting the transaction and can be used to approximate a deal's risk. Regarding this, a larger number of banks involved may lower the yield if investors associate a larger number of banks with a diversification of the transaction risks. Regarding AS transactions, Vink and Thibeault (2008) found that credit spread and number of lead managers are significantly negatively related for MBS and they have an insignificant relationship for ABS. Therefore, for AS we expect number of banks to have a negative influence on the spread [Sorge and Gadanecz (2008), Nadauld and Weisbach (2012)]. So, as yields similarly to spreads represents the costs of funding the same impacts are expected for our dependent variable yield to maturity.
- **Number of tranches:** represents the number of tranches in each transaction. AS issues are usually divided into one or more tranches. For each transaction, we computed manually the variable number of tranches. For CB and SB issues, it is possible to associate risk with the number of tranches. Riskier transactions might imply a lower number of tranches since and thus a negative coefficient is expected. For AS, the number of tranches allow us to analyse the impact of tranches on yields. Vink and Thibeault (2008) and Firla-Cuchra and Jenkinson (2006) find a significant and positive relationship between the number of tranches and the credit spreads. Thus, a positive coefficient between spread and number of tranches is expected for AS.
- **Tranche to transaction:** is the ratio between the tranche size and the transaction size of a given bond issuance. To calculate the ratio, we divided the tranche size over the transaction size using the

methodology proposed by Vink and Thibeault (2008). If the transaction only contains one tranche the value is 100%. For SB and CB, we expect that yield to maturity and tranche to transaction will have a significant positive relationship. This suggest that SB and CB lenders associate an increase in the tranche to transaction with a significant increase of yields. Quite the reverse, for AS bonds we expect that yield to maturity and tranche to transaction have a negative relationship. So, if the tranche to transaction is higher, we will expect a lower yield to maturity. In AS, there are several credit enhancement mechanisms that are implemented to improve the credit rating of the issued securities and reduce the risks transferred to investors. Is typical the creation of a credit risk mitigation device by subordination of tranches with lower size and higher default risk. These tranches will pay a higher interest rate to their investors that the senior tranches.

- **Fixed rate:** is a dummy variable that takes the value one if the bond has a fixed rate and zero otherwise. On bonds with fixed interest rate, the interests do not fluctuate and issuers are typically protected from the risk of rising interest rates. We expect borrowers to raise funds at a higher spread through fixed priced issues than through floating priced issues, so a positive sign is expected. Analysing some practical studies, Sorge and Gadanecz (2008) and Vink and Thibeault (2008) confirmed this and found that floating rate bonds have lower spreads.
- **Currency risk:** is a dummy variable that takes the value one for bonds that are denominated in a currency different from the deal's nationality and zero otherwise. It is expected that issues exposed to currency risk will have higher credit spreads than issues not exposed. Vink and Thibeault (2008) confirmed this expectation for AS bonds. So, as yields

similarly to spreads represents the costs of funding the same impacts are expected for this dependent variable.

- **Callable:** is a dummy variable set equal to one if the bond has a call option and zero otherwise. A callable bond is a bond that can be redeemed by the issuer at some point before maturity. Accordingly, a positive sign is expected for a callable bond as the issuer has an option to redeem the bond early, for which it pays in the form of a higher bond yield (Fabozzi and Kothari, 2007).
- **Rated:** dummy equal to 1 if the bond has a credit rating from S&P or Moody's and 0 otherwise. For AS is expected that the fact that a bond being rated by S&P or Moody's has a negative relationship with bond interest rate. It means that the rating from these agencies confers credibility for the AS and has impact on yields. For CB and SB, the impact sign can't be clearly determined [Ammer and Clinton (2004); Hu and Cantor (2006), Vink and Thibeault (2008), Sorge and Gadanecz (2008), Buscaino *et al.* (2012), Prokopczuk *et al.* (2013), Gürtler and Neelmeier (2016)].
- **Rating*rated:** is the interaction between a rated bond and its credit rating. Credit rating is the S&P and Moody's rating at bond issuance and the rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=22. For this variable is expected a positive impact on AS, CB and SB bonds yields [Ammer and Clinton (2004), Hu and Cantor (2006), Vink and Thibeault (2008), Sorge and Gadanecz (2008), Buscaino *et al.* (2012), (Prokopczuk *et al.* 2013), Gürtler and Neelmeier (2016)].
- **Log transaction size:** is the logarithm of the bond transaction size. Transaction size is the volume of the transaction of a given bond in Euros. It is expected a negative relationship between bond yields and

transaction size. This means that the higher the transaction size, the lower the yield [Vink and Thibeault (2008), Prokopczuk *et al.* (2013) Gürtler and Neelmeier (2016)].

- **Tranche size:** represents the amount of a given tranche in euros. Referring to AS, Maris and Segal (2002) found that tranche size influence negatively the AS spread. Similarly, Vink and Thibeault (2008), and Buscaino *et al.* (2012) found a negative impact of tranche size on the spread. We thus expect that the higher the tranche size the lower the yield to maturity.
- **Management fees (bps):** indicates the total management fee received for participating in the management group in basis points. Is expected that the higher the fee the higher the yield because it means more risk in the operation. Sironi and Gabbi (2005) used this variable on a study about corporate bonds that we will adapt to AS, CB and SB. Its results show that the relationship between corporate bonds yield and management fees is insignificant.
- **U.K. borrowers:** dummy equal to one if the issuer bank is located in the U.K. and 0 otherwise. Prokopczuk *et. al.* (2013) show that a bank being located in U.K faces higher CB spreads or in some regressions this relationship is insignificant. We thus expected a positive or insignificant relationship for CB.
- **Financial crisis:** it's a dummy variable that takes the value one if the issue date belongs to the 2007-2008 financial crisis and zero otherwise. We consider the financial crisis period from September 15, 2008 through April 23, 2010. Gerlach *et al.* (2010) found that financial crisis had a positive impact on SB spreads. Beirne *et al.* (2011) and Gürtler and Neelmeier (2016) found that it had a positive impact on CB yields and spreads, respectively. A positive coefficient is expected for all deal

types in study since the 2007/2008 financial crisis has resulted in a collapse of the economy, failing banking systems, business failures and a deterioration in consumer wealth.

- **Sovereign debt crisis:** is a dummy equal to one if the bond issue date belongs to the European sovereign debt crisis and zero otherwise. We consider the sovereign debt crisis from April 24, 2010 to the end date of our study December 31, 2016. Szczerbowicz (2015) found that sovereign debt crisis increased CB and SB spread. Beirne *et al.* (2011), Schuller (2013) and Gürtler and Neelmeier (2016) found that sovereign debt crisis increased CB spreads and yields. A positive coefficient is expected for all deal types in this study.
- **CBPP1:** dummy equal to one if the bond was issued during the first European covered bond purchase programme and 0 otherwise. The CBPP1 occurred from May 7, 2009 through June 30, 2010. Theoretically this programme should decrease CB yields, however looking for empirical studies it's not possible to determine its impact on AS bonds and CB. There is no empirical studies about its impact on AS bonds. For CB, the authors Schuller (2013), Szczerbowicz (2015), and Gürtler and Neelmeier (2016) found a negative relationship while Gibson *et al.* (2016) found a positive relationship. Finally, for SB this programme had a negative relationship with yields and spreads (Szczerbowicz, 2015). Regarding that, we can't predict the impact of this programme on CB and AS bonds based on empirical studies because we don't have empirical studies for AS bonds and we have diferent impacts for CB. However, for CB we expect that this programme as mentioned on theory would decrease yield. While for AS bonds, we can't predict any relationship and for SB we expect a negative relationship.

- **SMP:** dummy that takes the value one if the bond was issued during the securities market programmes 1 and 2 and zero otherwise. In this thesis SMP is considered to start on May 10, 2010 and end on September 6, 2012. Szczerbowicz (2015), Hofmann *et al.* (2016) and Gibson *et al.* (2016) found that this programmes decreased SB and CB spreads. The same impacts are expected for our dependent variable.
- **CBPP2:** dummy equal to one if the bond was issued during the second European covered bond purchase programme, from October 6, 2011 through October 31, 2012, and 0 otherwise. Theoretically this programme should decrease CB yields, however looking for empirical studies it's not possible to determine its impact on AS and CB. There are no empirical studies about its impact on AS bonds. For CB, Szczerbowicz (2015) found a negative relationship while Schuller (2013), Gibson *et al.* (2016) and Gürtler and Neelmeier (2016) found a positive relationship. Finally, according to Szczerbowicz (2015) for SB this programme had a negative relationship with yields and spreads. We expect that CBPP2 will decrease SB yields. For AS, we can't predict if there is any relationship. Finally, for CB we can't predict the impact, however based on theory we believe on the existence of a negative relationship.
- **3Y-LTRO:** dummy that takes the value one if the bond was issued during the three-year long-term refinancing operations and zero otherwise. The 3Y-LTRO occurred from December 8, 2011 to February 29, 2015. Using empirical studies, Szczerbowicz (2015) and Hofmann *et al.* (2016) found that 3Y-LTRO increases SB spreads. For CB, the authors found that 3Y-LTRO decreased spreads. Finally, for AS its expected a decrease as for CB.

- **TLTRO:** Dummy that takes the value one if the bond was issued during the targeted long-term refinancing operations, from June 5, 2014 to December 31, 2016, and zero otherwise. Heam *et al. (*2015) found that this operations decrease SB yields. Moreover, according to Gerba and Macchiarelli (2016) this measure was implemented to make banks lend more with low yields, so it's also expected that TLTROs decrease AS and CB yields.
- **ABSPP:** dummy equal one if the bond was issued during the European asset-backed securities purchase programme from September 4, 2014 through to December 31, 2016, and zero otherwise. Heam *et al.* (2015) and Hofmann *et al.* (2016) found that the ABSPP has a negative impact on SB yields an spreads, respectively. By contrast, Hofmann *et al.* (2016) found a positive relationship between ABSPP and CB. Finally, there are no empirical studies of the impact of this programme on AS. This one the main contributes from our study to the existent literature. However, theoretical studies allow us to predict a significant negative impact of ABSPP on AS yields (Blattner *et al.*, 2016).
- **CBPP3:** dummy equal to one if the bond was issued during the third European covered bond purchase programme and 0 otherwise. The CBPP3 occurred from September 4, 2014 to the end date of our study December 31, 2016. This programme decrease CB yields as verified by the empirical study of Hofmann *et al.* (2016). For AS there are no empirical studies. Moreover, for SB according to Heam *et al.* (2015) and Hofmann *et al.* (2016) there is a negative impact. So, we expect a negative relationship for CB and SB. However, for AS we can't predict the impact.
- **PSPP:** dummy that takes the value one if the bond was issued during the European public sector purchase programme and zero otherwise.

The PSPP is occurred from after January 22, 2015 to the end date of our study December 31, 2016., Hofmann *et al.* (2016) and Andrade *et al.* (2016) found that this programme decreases SB spreads and yields, respectively. For CB, Hofmann *et al.* (2016) found that this programme has a positive relationship with bond spreads. We expect a negative relationship between this programme and SB, a positive relationship with CB and we can't predict if there is any the impact on AS bonds.

- **CSPP:** dummy that takes the value one if the bond was issued during the European corporate sector purchase programme and zero otherwise. The CSPP occurred from March 10, 2016 to the end date of our study December 31, 2016. ECB (2016) and Abidi *et al. (2017)* found that this programme decreased corporate bond spreads.. Despite previous literature hasn´t examined the impact of this programme on SB, AS bonds and CB, we expect a negative relationship between CSPP and yields.
- **0% Deposit:** dummy that takes the value one if the bond was issued during the day of the ECB announcement of cutting to 0% the deposit rate and zero otherwise. The announcement occurred on July 5, 2012. Szczerbowicz (2015) found that the decrease of deposit rate to 0% increased SB spreads. For CB, the author found that it decreased the spread or had an insignificant impact. The same negative impact is expected for SB and CB when analysing the literature and given the proximity between CB and ABS, the same negative impact is expected in AS bonds against CB.
- **Draghi Speech:** dummy that takes the value one if the bond was issued on the day of Draghi Speech and zero otherwise. The speech occurred on July 26, 2012. Szczerbowicz (2015) and Gibson *et al.* (2016) found a negative impact on SB spreads. For CB, Gibson *et al.* (2016) found a

positive impact on spreads. The same negative impact is expected for SB and CB when analysing the literature and given the proximity between CB and ABS, the same negative impact is expected in AS bonds against CB.

- **Country risk:** this variable is approximated by Standard & Poor's country rating at the time of issuance. The rating is converted as follows: AAA=1, AA+=2, and so on until D=22. Given that, this variable measures from 1 for the countries with the lowest risk to 22 for the countries of highest risk. Gibson *et al.* (2016) performed an empirical study that includes country rating as a regressor to test the impact of country credit risk on sovereign bonds spread. He verified a better rating decreases the spread of sovereign bonds. Given that, is also expected the same effect on AS and CB spreads since banks headquartered in countries with lower risk tend to have a special protection in case of default (Zaghini, 2014). Arezki *et al.* (2011), also found that sovereign rating downgrades have statistically and economically significant spillover effects both across countries and financial markets. Finally, Caselli *et al.* (2016) studied the impact of sovereign rating changes on domestic bank shares prices and argues that the Committee on the Global Financial System in 2011 recognized that sovereign downgrades have direct negative repercussions on the cost of bank debt and equity funding.
- **Risk free rate:** we use as a proxy for the risk free rate the three-month German treasury bill at the time of issuing the bonds. Eichengreen and Mody (1998) and Kamin and Kleist (1999) found that the general level of interest rates impacts negatively the bonds yields. Is expected that risk free rate will have a significant negative impact on yields since higher yields mean better economic conditions and thus lower

probabilities of default [Collin-dufresne *et al.* (2001), Altavilla *et al.* (2015)].

- **Slope of the Euro swap curve (EUSA5y-Libor3M):** is obtained as the difference between the five-year Euro swap rate and the 3-month Libor rate.. Sorge and Gadanecz (2008) found that a sharper U.S. treasury yield curve is associated with lower yield. Hu and Cantor (2006) found that structured finance yields are highly correlated with the slope of the swap curve. Also, Fontana and Scheicher (2010) as Longstaff and Schwartz (1995) found for government bonds that increasing slope of the term structure should lead to a decrease in future spot rate. We expect that a sharper euro yield curve will reduce yields since it might represent a positive expectation on economic growth, leading to better financial performances.
- **Volatility:** refers to the quantity of uncertainty or risk related with changes in an asset's value. A high volatility means that the price of a financial asset can change much over a short period of time in an unknown direction. In contrast, a low volatility means that an asset's value doesn't oscillate intensely. We use the Chicago Board Options Exchange Volatility Index (VIX) as a proxy for market future volatility. The VIX estimate of volatility is based on the weighted average of the implied volatilities for a wide range of strikes. Is expected a positive relationship between volatility and yield to maturity as borrowers will require a higher return in the presence of higher volatility [Fabozzi and Kothari (2007), Gagnon *et al.* (2011a, 2011b), Szczerbowicz (2015), Gürtler and Neelmeier (2016)].
- **Log GDP:** yearly GDP data for each country that was measured as sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the

products. It was calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. The original data was in dollars however we transformed it to euros at current exchange rate and applied the logarithm. Matei and Cheptea (2013) found a negative relationship between GDP and SB spread. The same impact is expected for CB and ABS.

- **Government debt:** quarterly local government consolidated gross debt as a percentage of GDP. Matei and Cheptea (2013) and Gibson *et al.* (2016) found a positive relationship between government debt and SB spreads and yields. Because of bank and sovereign risk relationship is also expected a positive or relationship between government debt and AS and CB.

4. Univariate Analysis

This chapter provides a statistical analysis of asset securitization bonds (AS), covered bonds (CB), and sovereign bonds (SB) issued by banks and countries in European Union. In this section, will be compared yield to maturity and common pricing factors between the three types of bond issues.

4.1. Descriptive statistics by Bond Type

Table 1 presents descriptive statistics for AS bonds, CB and SB issued by European Union banks and countries during the 2000-2016 period. Table 2 provides nonparametric tests - Wilcoxon rank-sum test for continuous variables and Fisher's exact test for discrete variables - ,performing pair-wise comparisons of the yield to maturity and pricing characteristics between the three issue types and allows to understand if the variable differ or not significantly between the two security classes.

Tables 1 and 2 show that the average yield is economically and statistically higher for AS bonds (439.4 bps) than they are for CB (355.8 bps) and SB (312.5 bps) at the 5% significance level. Additionally, the average yield for CB is economically and statistically higher than the yield for SB. However, standard deviation is higher for AS bonds (244.7 bps), following the SB (179.6 bps) and the lowest CB (134.5 bps). Standard deviation is a measure used to quantify the amount of variation or dispersion around the mean value a set of data values. This means that AS bonds yield to maturity could differ more variate value than the other two deal types. Still, these univariate analyses do not allow us to control for other factors that are known to affect the pricing of bonds.

Variable of interest	Type of bond issue			Variable of interest	Type of bond issue		
	AS	CB	SB		AS	CB	SB
Continuous variables							
Yield to maturity (bps)				**Tranche to transaction (%)**			
Number	1,477	12,989	8,959	Number	1,477	12,989	8,959
Mean	439.4	355.8	312.5	Mean	28.2%	99.1%	98.9%
Median	475.0	357.0	322.0	Median	10.9%	100.0%	100.0%
Std. Dev.	244.7	134.5	179.6	Std. Dev.	34.3%	7.4%	8.1%
Transaction size (€ million)				**Number of banks**			
Number	1,477	12,989	8,959	Number	1,477	12,989	8,959
Mean	917.6	235.2	1,524.1	Mean	2.5	2.1	2.0
Median	495.5	63.5	973.0	Median	2.0	12,989	1.0
Std. Dev.	1,300.6	454.9	1,652.4	Std. Dev.	2.0	2.6	2.9
Tranche size (€ million)				**Number of tranches**			
Number	1,477	12,989	8,959	Number	1,477	12,989	8,959
Mean	190.6	224.7	1,508.1	Mean	5.3	1.0	1.0
Median	50.0	60.0	950.0	Median	5.0	1.0	1.0
Std. Dev.	353.1	410.4	1,647.9	Std. Dev.	3.4	0.2	0.3
Credit rating [1-22 weak]				**Country risk [1-22 weak]**			
Number	1,098	11,693	8,650	Number	1,477	12,989	8,959
Mean	4.3	1.5	3.0	Mean	1.8	1.3	3.0
Median	3.0	1.0	2.0	Median	1.0	1.0	1.0
Std. Dev.	3.6	1.4	2.6	Std. Dev.	2.1	1.2	2.9
Time to maturity (years)				**Management fee (bps)**			
Number	1,477	12,989	8,959	Number	68	688	306
Mean	20.9	6.1	9.6	Mean	40.6	10.4	14.5
Median	14.0	5.0	7.0	Median	37.5	8.0	12.0
Std. Dev.	18.1	4.8	8.5	Std. Dev.	25.7	6.8	10.4
Dummy variables							
Fixed rate				**Currency risk**			
Nº of issues with data available	1,477	12,989	8,959	Nº of issues with data available	1,477	12,989	8,959
Nº of issues with dummy=1	1,174	12,631	8,715	Nº of issues with dummy=1	392	1 341	527
% of total available data	79.5%	97.2%	97.3%	% of total available data	26.5%	10.3%	5.9%
U.K. borrowers				**Callable**			
Nº of issues with data available	1,477	12,989	8,959	Nº of issues with data available	1,477	12,989	8,959
Nº of issues with dummy=1	573	202	552	Nº of issues with dummy=1	615	1 923	86
% of total available data	38.8%	1.6%	6.2%	% of total available data	41.6%	14.8%	1.0%

Table 1: Summary statistics for a sample of AS bonds, CB and SB issued between January 1, 2000 and December 31, 2016

Variable of interest	Type of bond issue		
	AS vs CB	AS vs SB	CB vs SB
Continuous variables: Wilcoxon rank-sum z-test			
Yield to maturity (bps)	16.04	20.45	19.14
Credit rating [1-22 weak]	71.80	21.09	-61.88
Time to maturity (years)	118.73	84.70	-37.50
Tranche to transaction (%)	-144.06	-125.53	3.84
Country risk [1-22 weak]	16.03	-44.84	-58.77
Transaction size (€ million)	105.25	-5.44	-77.22
Tranche size (€ million)	-5.50	-77.30	-77.08
Number of tranches	144.70	126.16	-3.86
Number of banks	51.11	52.37	0.85#
Management fees (bps)	11.64	5.21	-9.21
Dummy variables: Fisher's exact test (p-values)			
Fixed rate	0.00	0.00	0.00
Currency risk	0.00	0.00	0.00
U.K. borrowers	0.00	0.00	0.00
Callable	0.00	0.00	0.00

Table 2: Tests of significance for the difference in values among AS, CB and SB issues

Notes: Table 2 presents the results of running the Wilcoxon rank-sum test for continuous variables and the Fisher's exact test for dummy variables. Tests compare the value of each variable in AS bonds sample, with the corresponding values in the CB sample; the value of each variable in AS bonds sample, with the corresponding values in the SB sample and the value of each variable in CB sample, with the corresponding values in the SB sample. The signal # indicates that the common pricing variables do not differ significantly between the two security classes at the 5% significance level. The signal * indicates that the proportion of tranches for which dummy = 1 does not differ significantly between the two security classes.

Thus, in section 5 we will regress the yield against contractual characteristics as well as macroeconomic factors.

The average credit rating for AS bonds (4.3) is significantly worse than the credit rating for SB (3.0) and CB (1.5), at the 5% significance level. These credit ratings suggest that both AS bonds and SB are riskier than CB. However, relating the credit rating with the yield we can conclude, as expected, that AS bonds have the worse average rating and simultaneously the higher yield. This is in line with the premise that the better the credit rating the lower the yield. In addition, the yield is higher for CB than for SB but the credit rating is better for CB than for SB,

which contradicts the premise above. Resuming, credit rating is better for CB because one of the most referred benefits of CB is that the collateral assets remain on the originator's balance sheet, so issuers have an incentive to maintain high quality assets on their balance sheet, giving a positive signal to markets. However, yield to maturity analysis differs from credit rating analysis and suggest that AS bonds are the riskiest asset and SB the less risky. Moreover, observing the average country risk, we conclude that the average country risk for SB (3.0) is higher than for AS bonds (1.8) and CB (1.3).

An AS bond of average size matures over just 20.9 years, which is a long period if we compare it with the SB mean (median) of 9.6 (7.0) and CB mean (median) of 6.1 (5.0). This is a standard AS bonds characteristic, since in AS bonds the maturity of the securities issued typically matches the maturity of the assets used as collateral, which are characterized by longer maturity levels (Vink and Thibeault, 2008). In line with Packer *et al.* (2007) we can see that AS bonds, CB and SB tend to have fixed rates. However, the percentage of fixed rates is higher for SB (97.3%) and CB (97.2%) than for AS bonds (79.5%). Additionally, SB are almost always maintained until maturity and only 1% are callable. Additionally, 14.8% and 41.6% of CB and AS bonds are callable, respectively.

The average number of banks participating in an AS bond issue is 2.5 which is significantly higher than the average of 2.1 for CB and 2.0 for SB. Moreover, for CB and SB the number of banks does not differ significantly at 5% level. This is the case because AS transactions are complex structures in which several banks work together in structuring the deal. Looking for management fees in AS bonds the average (median) is 40.6 bps (37.5 bps), that is significantly higher than 10.4 bps (8.0 bps) for CB and 14.5 bps (12.0 bps) for SB.

The mean (median) tranche size of AS bonds is €190.6 million (€50.0 million). Compared to the mean (median) tranche size of €224.7 million (€60 million) for the CB sample, AS bonds tranches are significantly smaller. Additionally, the

mean (median) tranche size of €1 508.1 million (€950.0 million) for SB is the highest when comparing the tree deal types. The average number of tranches per transaction is higher for AS bonds (5.3) and equal for CB (1.0) and SB (1.0). The average tranche-to-transaction ratio for AS bonds (28.2%) is significantly lower than that for SB (98.9%) and CB (99.1%). Thus, we can conclude that AS transactions benefit from tranching. The transaction size is significantly higher for SB - with a mean (median) of €1524.1 million (€973.0 million) - than AS bonds - with a mean of €917.6 million (€495.5 million) - and CB - with a mean of €235.3 million (€63.6 million).

In the AS bonds, 26.6% of the issues are subject to currency risk, which compare to a mere 10.3% in CB and 5.9% in SB. Finally, the percentage of U.K. borrowers is much higher for AS bonds than for CB and SB. In the AS bonds sample, 38.8% of the issues belong to U.K. borrowers, compared to a mere 6.2% in the SB sample and only 1.6% in CB sample.

We will examine bond pricing characteristics deeply in section 5, when we employ OLS regressions to determine the impact of ECB unconventional monetary policies on AS bonds, CB and SB yield, controlling for contractual characteristics a macro factors. In short, our results indicate that the common pricing characteristics differ significantly in value between the three types of bond issues, with exception of number of banks between CB and SB. Given that, we would expect its impact on pricing to be bond-specific.

4.2. Yield to maturity over time by Country and Deal Type

In this section, an evolution of yield to maturity along time for the three types of bonds (AS, CB and SB) is presented. The analysis is based on descriptive

statistics (number of observations, mean and median) of yield to maturity along time in each of the 21 countries considered in this study.

Observing the mean results for AS bonds in Table 3 we can conclude that the 2007-2008 financial crisis increased AS bond yields. The impacts are visible in the 2008-2010 period mainly for the following countries: Germany, France, Ireland, Luxembourg, Netherlands, Portugal, Spain and United Kingdom. Moreover, it's also possible to verify an increase of AS bond yields in 2012 and 2013 for Ireland and Luxembourg. In addition, in 2014 and 2015 the yield to maturities increased for Finland, France, Germany, Ireland, Portugal and Spain. The mentioned increases since 2012 could be the effects of the European sovereign debt crisis. However, the tendency for European countries is a decrease on AS bond yield in more recent years, which can be caused by ECB quantitative easing measures to decrease financing costs. As sovereign debt crisis was a consequence of financial crisis it caused an impact more severe in countries that had financial problems and higher country ratings. The issuance of AS bonds decreased after the financial crisis which is supported by the number of observations for Austria, France, Germany, Ireland, Luxembourg, Netherlands, and United Kingdom. This decrease on the issuance of AS bonds happened because some securitized assets as collateralized debt obligations (CDOs), synthetic CDOs and squared CDOs may contributed to the start of financial crisis 2008. Since then, all colaterized assets started to be viewed as instruments with as too much risk.

In the next section, we will perform a regression analysis to study how these measures (SMP, CBPP 1, 2 and 3, ABSPP, PSPP, CSPP, TLTRO, 3Y LTRO and deposit rate cut) impacted on bond yields. Moreover, for some European central countries (e.g.: Germany, France) bonds have negative yields, which contributes for the decreasing tendency for Europe. However, the peripherical countries as Greece, Portugal, Spain, Ireland, Italy have the highest yields.

Country		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	All AS
Austria	Number:		5		1		1	13		1									21
	Mean:		679.6		539.7		800.0	177.5		0.0									439
	Median:		(684.2)		(539.7)		(800.0)	(70.0)		(0.0)									(539.7)
Belgium	Number:		1						1								2		4
	Mean:		602.4						419.8								363.2		1,385.4
	Median:		(602.4)						(419.8)								(363.2)		(419.8)
Finland	Number:	2		1											3		5	5	16
	Mean:	594.2		634.0											90.6		334.9	240	379
	Median:	(594.2)		(634.0)											(90.6)		(210.0)	(329.2)	(329.2)
France	Number:	9	8	2	13	4	3	22	6	3	2			16	6	1	13	5	113
	Mean:	722.3	632.6	569.6	466.7	541.6	506.6	418.1	543.9	255.3	380.0			212.8	266.8	-854.3	262.7	284.8	347.3
	Median:	(612.8)	(615.9)	(569.6)	(452.7)	(563.1)	(512.5)	(404.0)	(480.8)	(140.8)	(380.0)			(201.8)	(263.8)	(-854.3)	(284.8)	(146.0)	(404.0)
Germany	Number:	35	13	11	34	13	26	27	18	10	12	6	8	13	13	24	18	25	306
	Mean:	732.9	714.6	597.3	624.5	666.1	452.3	432.3	348.4	90.7	536.1	464.2	350.0	323.6	261.6	80.7	414.0	111.3	7,200.4
	Median:	(679.7)	(671.0)	(518.9)	(569.6)	(493.2)	(395.1)	(442.6)	(226.2)	(0.0)	(455.75)	(475.0)	(275.05)	(245.0)	(250.0)	(75.45)	(335.1)	(100.0)	(395.1)
Greece	Number:	1									4								5
	Mean:	600.6									239.8								420.2
	Median:	(600.6)									(239.6)								(420.1)
Ireland	Number:	1		3	15		14	2	10	9					2	5	8	8	77
	Mean:	959.9		491.1	531.8		577.9	581.7	306.5	379.3					577.1	293.1	319.34	344.3	487.4
	Median:	(959.9)		(492.6)	(470.2)		(497.4)	(581.65)	(413.4)	(292.9)					(577.05)	(313.6)	(268.05)	(148.9)	(470.2)
Italy	Number:	3	4	5	9	5	1	1	1	5	5	1	3	8		1	6	24	82
	Mean:	618.5	768.5	661.2	478.1	447.0	438.2	0.0	1,500.0	340.2	254.2	300.0	250.7	190.3		181.2	171.5	354.1	435
	Median:	(649.1)	(796.0)	(645.0)	(494.0)	(487.9)	(438.2)	(0.0)	(1,500.0)	(451.0)	(200.0)	(300.0)	(235.1)	(109.55)		(181.2)	(171.1)	(278.2)	(369.1)
Luxembourg	Number:		5	6				1	1	2	1			1					17
	Mean:		797.1	650.1				218.2	0.0	489.9	225.0			431.7					401.7
	Median:		(699.6)	(606.5)				(218.2)	(0.0)	(489.9)	(225.0)			(431.7)					(431.7)
Netherlands	Number:	26	20	23	46	4	2	7		6	1	3	16	15	8	6	1	11	195
	Mean:	689.9	646.4	590.7	504.6	626.0	521.1	608.5		133.3	420.0	506.9	226.5	33.4	197.8	255.8	68.5	276.5	394.1
	Median:	(693.8)	(606.5)	(530.9)	(455.7)	(497.4)	(521.1)	(474.0)		(100.0)	(420.0)	(500.0)	(218.0)	(1.0)	(256.4)	(263.2)	(68.5)	(255.0)	(437.9)
Portugal	Number:	1	2							1	5					1	1	1	12
	Mean:	612.0	566.8							-13.6	215.0					300.0	200.4	244.8	303.6
	Median:	(612.0)	(566.8)							(-13.6)	(0.0)					(300.0)	(200.4)	(244.8)	(244.8)
Spain	Number:			1	5	3	3		2	3	7				7	31	1	6	69
	Mean:			675.0	692.1	400.4	349.4		653.6	195.7	459.8				150.2	154.3	329.7	442.2	409.3
	Median:			(675.0)	(692.1)	(423.5)	(345.1)		(653.6)	(0.0)	(375.0)				(119.9)	(146.3)	(329.7)	(494.7)	(375.0)
United Kingdom	Number:	53	92	73	96	45	28	46	21	11	4	6	6	8	12	26	23	23	573
	Mean:	698.2	636.5	556.1	528.5	610.4	492.6	392.9	216.9	391.3	602.5	464.3	780.2	649.8	494.2	215.6	209.6	343.6	487.3
	Median:	(696.6)	(643.0)	(583.7)	(552.1)	(551.4)	(517.95)	(467.4)	(0.0)	(400.0)	(570.4)	(465.8)	(565.05)	(467.5)	(510.2)	(189.0)	(188.9)	(238.1)	(510.2)

Table 3: Asset securitization bond yields to maturity across time by country

Notes: Each cell contains the number of observations, mean and median (in parentheses).

Observing the mean results for CB on table below (see Table 4) we can conclude that the 2008 financial crisis increased CB yields for Finland, Greece, Ireland, Italy, Portugal and Spain. This effect is visible from the 2005-2009 period. Additionally, the subsequent European sovereign debt crisis increased CB yields issued in 2010 and 2011 by banks domiciled mainly in Belgium, Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom. However, the European general tendency is a decrease on CB yields along the years, which can be explain by ECB quantitative easing measures to decrease financing costs (SMP, CBPP 1, 2 and 3, ABSPP, PSPP, CSPP, TLTRO, 3Y LTRO and cut the deposit rate). The issuance of CB bonds increased significantly after the financial crisis, mainly in the following countries: Denmark, Finland, France, Greece, Netherlands, Portugal, Spain and United Kingdom. This tendency is related with CB being a good alternative to AS bonds, as mentioned by Lucas *et al.* (2008), Bernanke (2009) and Carbo-Valverde *et al.* (2013). Observing the mean results for SB on table below (see Table 5) we conclude that the 2007-2008 financial crisis increased SB yields in Austria, Greece, Italy, Luxembourg, Lithuania, Portugal, Slovak Republic and Slovenia. This impact is visible in the 2005-2009 period. The impact of sovereign debt crisis is clear in 2010 and 2011 for Belgium, Cyprus, France, Germany, Greece, Ireland, Italy, Lithuania, Portugal, Spain, Slovak Republic and Slovenia. However, the European general tendency is a decrease on SB yields along the years. The number of SB issues increased on Belgium, Cyprus, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Lithuania, Portugal, Spain and United Kingdom. The increase or decrease of SB issues is related with the way a country manages its funding needs to solve the problems caused by crisis.

Country		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	All CB
Austria	Number:	11	12	24	26	7	17	6	7	11	24	11	7	8	6	8	10	18	213
	Mean:	621.2	507.5	481.3	433.1	409.1	260.4	280.8	399.3	455.3	304.8	221.3	271.5	246.0	183.9	144.4	61.3	57.9	314.1
	Median:	(600.0)	(474.9)	(500.0)	(456.0)	(435.8)	(278.6)	(276.8)	(421.5)	(459.9)	(292.4)	(221.6)	(230.8)	(223.1)	(181.0)	(143.4)	(53.4)	(44.1)	(278.6)
Belgium	Number:	48	68	83	86	130	136	66	65	74	30	35	22	2	11	9	5	5	875
	Mean:	516.4	457.0	416.0	304.0	448.9	384.5	423.0	457.0	444.5	363.0	304.6	398.2	125.9	227.8	106.0	62.2	40.7	322.3
	Median:	(529.6)	(466.0)	(406.6)	(302.8)	(394.5)	(313.0)	(391.6)	(450.0)	(453.3)	(336.2)	(312.5)	(425.0)	(125.9)	(273.5)	(111.1)	(47.7)	(26.7)	(336.2)
Denmark	Number:						1	1				1	2	1			1		7
	Mean:						271.4	388.4				264.9	333.8	172.6			28.5		243.3
	Median:						(271.4)	(388.4)				(264.9)	(333.8)	(172.6)			(28.5)		(268.2)
Finland	Number:							1	3	1	3	3	3	4	1	5	4	6	34
	Mean:							388.2	460.9	497.3	334.6	256.0	337.2	220.4	116.7	99.2	44.9	17.6	252.1
	Median:							(388.2)	(454.8)	(497.3)	(317.5)	(249.6)	(330.8)	(228.1)	(116.7)	(101.6)	(41.5)	(20.0)	(249.6)
France	Number:	16	19	45	47	45	49	68	75	58	90	107	144	62	39	39	46	54	1,003
	Mean:	584.1	461.0	334.5	384.1	413.4	358.07	391.5	460.0	440.8	390.6	292.7	360.2	309.6	228.5	168.2	70.0	82.9	337.1
	Median:	(587.7)	(518.8)	(316.4)	(400.6)	(429.9)	(352.5)	(386.2)	(448.5)	(455.5)	(416.0)	(267.5)	(368.0)	(299.3)	(243.4)	(175.0)	(61.4)	(85.65)	(368.0)
Germany	Number:	696	827	939	1260	922	978	654	488	595	944	358	143	104	116	91	87	75	9,277
	Mean:	529.9	451.4	419.9	334.7	318.3	303.2	371.4	434.6	440.0	287.2	241.9	272.9	166.4	155.7	115.6	47.4	60.4	291.2
	Median:	-546.5	-458.9	-424.5	-325.9	-307.9	-296.7	-374.3	-443.3	-452	-285.7	-237.55	-272.4	-169.7	-150	-108.7	-36	-38.6	(296.7)
Greece	Number:										1	1							2
	Mean:										400.2	191.4							295.8
	Median:										(400.2)	(191.4)							(295.8)
Ireland	Number:					1	1	9	6	1	7	6		2	6	4	7	1	51
	Mean:					353.0	336.3	388.8	444.9	482.0	472.9	461.7		320.2	296.3	292.3	97.0	91.7	336.4
	Median:					(353.0)	(336.3)	(381.3)	(471.1)	(482.0)	(465.3)	(504.8)		(320.1)	(300.8)	(296.7)	(72.2)	(91.7)	(344.7)
Italy	Number:	62	32	35	58	49	52	53	17	24	32	29	31	12	20	34	37	11	588
	Mean:	535.4	452.3	413.6	352.2	310.6	281.9	363.8	378.0	474.5	296.1	267.4	408.4	338.1	265.7	151.4	73.1	33.2	317.4
	Median:	(545.5)	(461.0)	(410.0)	(351)	(290.3)	(279.5)	(378.0)	(420.2)	(489.5)	(291.5)	(261.3)	(429.6)	(349.6)	(277.6)	(123.9)	(68.8)	(26.9)	(349.6)
Luxembourg	Number:								1										1
	Mean:								274.7										274.7
	Median:								(274.7)										(274.7)
Netherlands	Number:	2	2	1	4			2	6	11	4	11	14	17	10	2	8	10	104
	Mean:	573.1	494.2	487.5	305.6			318.2	385.1	405.0	407.6	309.6	337.6	253.9	212.2	187.3	66.4	99.3	322.8
	Median:	(573.1)	(494.2)	(487.5)	(281.1)			(318.2)	(387.1)	(365.9)	(416.3)	(346.0)	(358.8)	(242.0)	(216.0)	(187.3)	(44.3)	(92.5)	(346.0)
Portugal	Number:							1	4	5	5	2			1	1	1		20
	Mean:							395.9	360.9	523.2	346.2	383.1			383.5	312.0	109.9		351.8
	Median:							(395.9)	(475.4)	(538.0)	(340.8)	(383.1)			(383.5)	(312)	(109.9)		(383.3)

Spain	Number:	2	5	7	19	22	29	47	41	23	43	56	102	28	18	10	21	25	498
	Mean:	595.2	506.0	494.0	409.9	410.9	362.1	405.9	459.3	526.9	348.9	350.4	434.0	492.3	321.6	196.7	90.3	127.1	384.2
	Median:	(595.2)	(531.5)	(507.8)	(404.8)	(421.9)	(364.6)	(407.0)	(452.5)	(536.0)	(344.6)	(351.8)	(440.3)	(486.2)	(314.4)	(194.4)	(87.7)	(100.0)	(407.0)
Sweden	Number:	13	8	10	21	19	21	8	7	4	10	2	5	5	3	1	5	2	144
	Mean:	480.3	531.6	405.3	335.0	317.7	293.4	324.2	428.6	462.6	278.1	169.7	283.3	187.5	116.1	129.8	63.3	28.3	284
	Median:	(467.0)	(472.7)	(419.3)	(335.6)	(300.8)	(291.1)	(355.85)	(411.4)	(457.5)	(265.9)	(169.7)	(257.8)	(228.8)	(138.5)	(129.8)	(67.8)	(28.3)	(291.1)
United Kingdom	Number:				2	8	8	22	20	5	3	29	44	15	4	8	16	18	202
	Mean:				420.0	455.7	373.7	372.7	441.9	403.2	382.8	335.3	409.5	404.2	203.0	116.3	88.9	101.3	322.0
	Median:				(420.0)	(460.2)	(365.8)	(390.0)	(461.3)	(403.5)	(375.6)	(322.1)	(412.4)	(427.2)	(195.6)	(105.8)	(74.5)	(134.8)	(382.8)

Table 4: Covered bonds yield to maturity across time by issuer country

Notes: Each cell contains the number of observations, mean and median (in parentheses).

Country		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	All SB
Austria	Number:	12	18	36	23	27	31	21	25	17	22	21	21	21	20	24	27	31	397
	Mean:	528.0	423.1	436.1	416.8	514.8	622.3	789.9	953.7	375.7	361.1	289.9	292.5	228.0	191.6	138.2	58.6	59.8	392.9
	Median:	(529.6)	(447.9)	(436.7)	(412.3)	(434.9)	(550.0)	(500.0)	(525.9)	(379.9)	(373.1)	(323.0)	(317.2)	(245.2)	(192.0)	(127.2)	(41.7)	(44.8)	(379.9)
Belgium	Number:	15	8	14	12	12	12	10	14	19	31	37	41	42	47	31	38	63	446
	Mean:	558.9	490.1	483.6	410.8	413.8	338.8	382.2	430.6	423.4	326.7	305.3	402.5	284.2	263.5	199.6	131.8	95.8	349.5
	Median:	(557.2)	(499.6)	(489.7)	(419.6)	(428.4)	(336.4)	(382.3)	(428.2)	(430.7)	(330.9)	(312.5)	(409.0)	(301.2)	(278.0)	(217.0)	(124.0)	(102.0)	(382.3)
Cyprus	Number:			1		1					1	2		1		1	2	1	10
	Mean:			562.0		446.4					384.2	426.3		600.0		485.0	412.5	380.0	462.1
	Median:			(562.0)		(446.4)					(384.2)	(426.3)		(600.0)		(485.0)	(412.5)	(380.0)	(436.4)
Finland	Number:	7	5	2	4	3	2	2	4	2	3	14	11	13	11	7	12	12	114
	Mean:	541.3	483.1	459.9	307.7	397.9	277.2	213.1	426.4	394.2	293.1	291.3	258.6	201.3	181.9	166.1	90.1	54.0	296.3
	Median:	(543.6)	(499.4)	(459.9)	(296.6)	(433.8)	(277.2)	(213.0)	(433.3)	(394.2)	(319.1)	(318.9)	(235.2)	(227.5)	(177.4)	(180.2)	(98.8)	(46.5)	(296.6)
France	Number:	60	50	43	55	52	36	50	54	76	98	95	97	108	116	129	115	84	1,318
	Mean:	483.5	459.1	414.7	319.6	310.7	295.5	335.3	360.8	346.2	267.3	227.5	262.6	215.9	204.3	156.1	90.5	35.0	281.4
	Median:	(512.2)	(461.3)	(409.8)	(300.4)	(310.1)	(317.2)	(367.1)	(405.1)	(373.0)	(252.7)	(203.2)	(267.7)	(221.8)	(243.9)	(185.9)	(96.4)	(28.7)	(300.4)
Germany	Number:	65	72	95	105	102	149	125	121	114	123	177	157	117	147	195	181	173	2,218
	Mean:	539.9	458.5	422.8	349.2	390.8	342.5	379.7	467.1	379.8	260.8	208.3	250.9	140.4	126.8	115.0	42.9	35.5	288.9
	Median:	(553.2)	(471.3)	(444.1)	(350.0)	(371.4)	(301.4)	(375.0)	(429.3)	(408.9)	(265.0)	(225.0)	(269.5)	(156.0)	(149.2)	(116.3)	(41.8)	(28.2)	(301.4)
Greece	Number:	28	12	12	16	14	15	11	13	15	7	4				2			149
	Mean:	612.5	489.9	465.6	391.8	343.2	385.7	387.4	428.4	427.6	510.3	615.7				422.5			456.7
	Median:	(613.7)	(499.8)	(468.6)	(413.4)	(322.5)	(312.8)	(379.6)	(442.1)	(468.9)	(537.9)	(612.0)				(422.5)			(455.4)
Estonia	Number:														2				2
	Mean:														357.0				357.0
	Median:														(357.0)				(357.0)
Ireland	Number:	8		10	9	6	3		1	2	19	3		9	2	7	8	7	94
	Mean:	551.5		482.0	381.5	466.9	359.2		458.1	427.0	411.4	428.8		574.2	373.3	274.0	154.05	70.5	386.6
	Median:	(547.3)		(489.6)	(374.7)	(468.1)	(350.5)		(458.1)	(427.0)	(391.3)	(474.5)		(588.9)	(373.3)	(290.4)	(160.8)	(82.0)	(409.1)
Italy	Number:	90	95	87	83	67	70	71	65	74	80	81	67	88	63	68	83	89	1,321
	Mean:	528.5	466.2	445.4	331.8	338.1	299.2	372.2	399.8	406.9	347.9	311.4	486.2	447.4	329.4	211.7	131.8	101.8	350
	Median:	(529.7)	(457.0)	(449.0)	(302.1)	(328.3)	(290.1)	(378.0)	(419.1)	(428.7)	(337.1)	(285.2)	(485.5)	(445.8)	(337.6)	(210.0)	(126.9)	(82.6)	(337.6)
Luxembourg	Number:									1		1		1	3	1			7
	Mean:									370.5		339.0		229.2	240.0	43.6			1,222.3
	Median:									(370.5)		(339.0)		(229.2)	(228.5)	(43.6)			(229.2)
Netherlands	Number:	8	9	9	11	8	12	9	7	11	39	28	21	25	16	20	20	18	271
	Mean:	520.0	468.4	447.6	352.2	357.3	290.2	368.1	429.4	374.9	279.4	228.6	235.4	138.1	130.8	107.3	46.9	45.2	283.5
	Median:	(519.2)	(485.5)	(458.8)	(366.9)	(336.6)	(278.4)	(370.8)	(423.9)	(376.2)	(293.8)	(232.3)	(223.8)	(130.4)	(130.3)	(83.3)	(23.0)	(30.4)	(293.8)
Lithuania	Number:	18	32	30	29	18	1	2	1		4	6	9	28	9	27	48	51	313
	Mean:	1,057.9	691.1	503.3	428.1	356.0	377.9	388.9	487.0		849.9	473.1	550.0	438.3	334.5	277.2	160.8	119.2	468.3
	Median:	(1,030.5)	(680.5)	(494.6)	(427.6)	(337.7)	(377.9)	(388.9)	(487.0)		(856.6)	(437.0)	(545.7)	(451.9)	(263.1)	(259.9)	(209.9)	(113.2)	(437.0)
Portugal	Number:	9	11	14	5	7	11	10	8	12	12	27	6		2	10	13	10	167
	Mean:	556.3	484.8	472.5	300.6	373.9	335.8	385.3	446.7	462.4	400.1	463.0	585.2		527.7	423.0	259.4	284.7	422.6
	Median:	(553.7)	(516.2)	(483.7)	(265.4)	(370.3)	(336.9)	(389.7)	(439.45)	(462.4)	(422.7)	(452.1)	(589.4)		(527.7)	(426.9)	(242.9)	(289.5)	(433.2)

Spain	Number:	62	43	39	35	38	34	34	22	36	100	93	114	150	147	86	78	90	1,201
	Mean:	549.0	507.2	473.5	364.5	370.0	326.5	375.3	421.7	398.7	335.5	422.7	514.9	477.2	435.8	251.6	141.1	138.5	382.6
	Median:	(552.6)	(517.6)	(488.8)	(383.8)	(386.0)	(331.4)	(391.5)	(424.4)	(398.1)	(339.0)	(435.0)	(500.0)	(475.1)	(436.4)	(218.3)	(128.3)	(144.2)	(398.1)
United Kingdom	Number:	5	6	12	19	20	21	30	33	49	67	53	46	37	34	32	39	49	552
	Mean:	293.0	401.5	386.2	422.8	393.6	346.2	303.8	339.0	313.1	283.7	266.3	230.9	197.4	202.5	241.3	133.0	49.3	282.6
	Median:	(445.9)	(487.2)	(483.1)	(443.2)	(472.5)	(431.9)	(397.5)	(446.2)	(402.3)	(308.2)	(281.5)	(223.0)	(193.0)	(208.3)	(271.5)	(168.8)	(86.3)	(397.5)
Malta	Number:	1		2															3
	Mean:	560.0		527.7															543.9
	Median:	(560.0)		(527.7)															(543.9)
Slovak Republic	Number:	22	31	20	3	6	4	2	10	15	16	18	13	23	20	17	17	20	257.0
	Mean:	910.4	779.9	769.0	500.0	516.9	357.2	442.3	390.2	475.6	390.6	328.2	409.6	346.8	275.0	293.9	254.7	59.7	441.2
	Median:	(853.0)	(778.8)	(773.0)	(500.0)	(535.4)	(365.0)	(442.3)	(435.0)	(463.6)	(385.1)	(340.6)	(429.0)	(385.2)	(299.9)	(300.0)	(337.3)	(69.1)	(429.0)
Slovenia	Number:	13	17	16	6	13	14	9	2	1	3	2	2	1	2	6	4	6	117
	Mean:	494.3	502.6	569.4	574.4	465.2	382.4	394.1	417.5	443.0	443.9	350.4	479.2	570.0	555.3	300.1	252.1	205.1	435.2
	Median:	(464.4)	(492.6)	(549.9)	(536.8)	(478.2)	(382.4)	(393.6)	(417.5)	(443.0)	(441.2)	(350.4)	(479.2)	(570.0)	(555.3)	(273.5)	(268.9)	(206.9)	(443.0)

Table 5: Sovereign bonds yield to maturity across time by issuer country

Notes: Each cell contains the number of observations, mean and median (in parentheses).

In the next section, we will perform a regression analysis to study how these measures (SMP, CBPP 1, 2 and 3, ABSPP, PSPP, CSPP, TLTRO, 3Y LTRO and deposit rate cut) impacted on bond yields. Moreover, for some European central countries (e.g.: Germany, France) bonds have negative yields, which contributes for the decreasing tendency for Europe. However, the peripherical countries as Greece, Portugal, Spain, Ireland, Italy have the highest yields.

4.3. Yield to Maturity by Deal Type

Table 6 and Figure 2 show, as expected, that AS is the financial instrument with the highest yield to maturity during the 2000-2016 period. This can be verified by the results presented for Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands and United Kingdom. However, for Greece, Spain and Portugal the results are contradicted and SB are the asset with the highest yield to maturity.

Also,

Table ***6*** and Figure 2 shows that in general CB are the asset with the second higher yield to maturity as is supported by the results from Belgium, France, Germany, Luxembourg, Netherlands, Portugal, Spain and United Kingdom. However, for Austria, Finland, Ireland and Italy the results are contradicted and SB are the second asset with the higher yield. For Greece, the second costly asset is AS bonds.

Additionally, the results show that SB are the asset with the lower yield as supported by Belgium, France, Germany and United Kingdom. However, for Austria Finland Greece, Italy and Ireland the asset with the lower yield was CB and for Cyprus Portugal and Spain the asset with the lower yield was AS bonds.

In general, the results show that SB are safest than bank bonds (AS and CB).

	AS	CB	SB
Austria	8 592.2 (629.4)	213 328.8 (325.0)	397 389.9 (352.5)
Belgium	4 437.2 (391.5)	875 402.6 (400.0)	446 292.4 (305.3)
Cyprus			10 453.5 (435.7)
Denmark		7 256.2 (271.4)	
Finland	16 338.4 (225.0)	34 200.8 (161.9)	113 248.3 (231.0)
France	113 399.1 (375.0)	973 332.9 (361.3)	1,318 250.8 (250.1)
Germany	306 437.3 (442.6)	9,277 357.5 (353.2)	2,217 253.8 (246.2)
Greece	5 311.9 (254.1)	2 295.8 (295.8)	149 460.4 (465.5)
Estonia			3 411.0 (357.0)
Ireland	77 442.5 (416.7)	51 348.6 (363.0)	94 388.5 (417.1)
Italy	82 389.9 (364.1)	588 336.5 (343.0)	1,321 351.6 (377.2)
Luxembourg	17 573.0 (583.0)	1 274.7 (274.7)	7 243.2 (229.2)
Netherlands	195 454.2 (462.2)	104 282.2 (281.8)	271 238.9 (248.4)
Lithuania			313 397.7 (378.3)
Portugal	12 296.0 (272.4)	20 387.9 (389.7)	166 419.8 (433.2)
Spain	69 294.4 (262.4)	498 381.6 (400.0)	1,201 383.8 (413.4)
Sweden		144.00 330.21 (322.9)	
United Kingdom	573 513.8 (542.7)	202 329.1 (349.4)	552 254.7 (255.3)
Malta			7 555.1 (555.8)
Slovak Republic			257 463.1 (437.3)
Slovenia			117 448.4 (440.7)

Table 6: Yield to maturity by deal type and issuer country.

Note: Each cell contains the number of observations, mean and median (in parentheses).

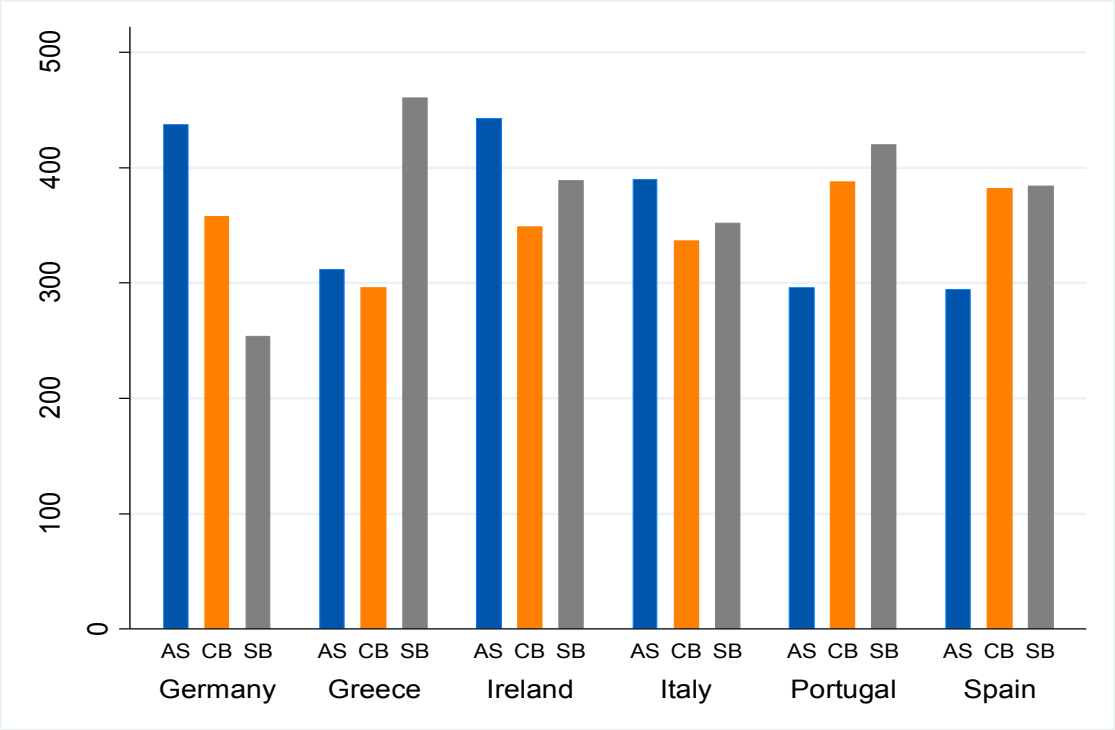

Figure 2: Yield to maturity by deal type and issuer country

Nevertheless, it contradicts the results from Table 1 concluded from looking to the average credit rating that suggested that both AS bonds and SB are considered riskier than CB.

Figure 3 presents the evolution of the yield to maturity between 2000 and 2016 by deal type. From Figure 3 we can conclude that there was a decrease of yields along time for the three types of bonds. Moreover, the financial crisis 2007/2008 affected significatively the AS bonds yield.

The sovereign debt crisis affected CB and SB yields. After 2011, yields were significantly reduced in a continuous way. Finally, after the sovereign debt crisis, AS bonds yield fall and then recover in recent years

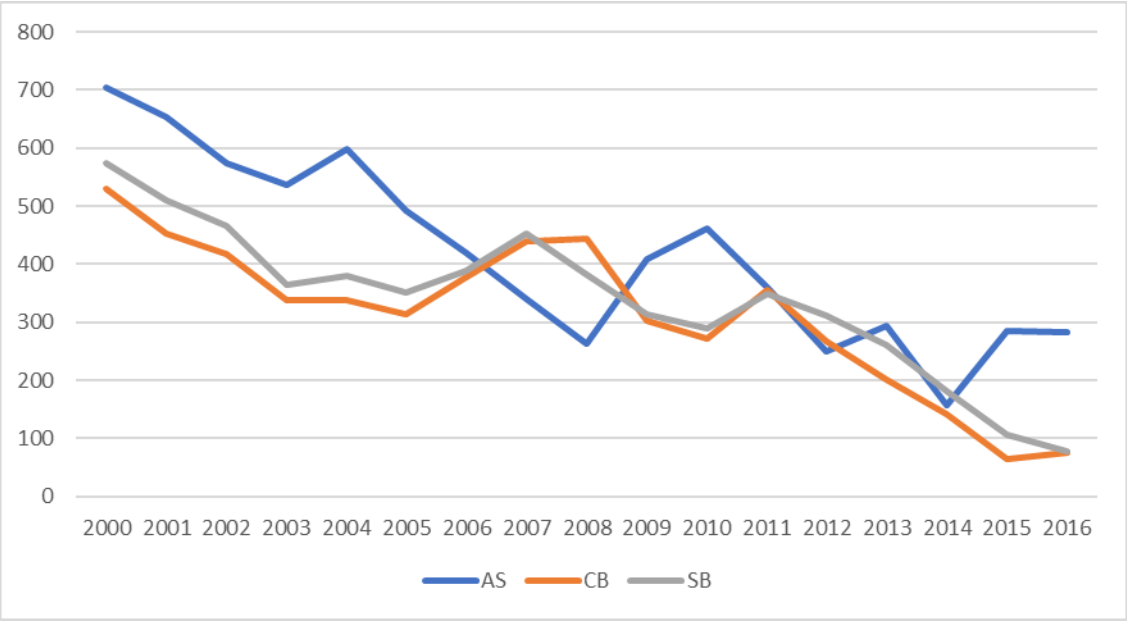

Figure 3: Yield to maturity across time by deal type

5. Regression Analysis

In this section, an OLS regressions analysis to test our hypotheses is implemented. A sample of tranche-level observations is used, so it is expected that the standard errors for tranches belonging to the same transaction are correlated with each other. We thus estimate standard errors clustered by transaction. Additionally, in employing OLS regressions techniques we adjust for heteroskedasticity. The specification of the initial model is:

$$\text{Credit spread}_i = \alpha + \beta_1 \text{SMP}_i + \beta_2 \text{ABSPP}_i + \beta_3 \text{CBPP1}_i + \beta_4 \text{CBPP2}_i + \beta_5 \text{CBPP3}_i + \beta_6 \text{PSPP}_i + \beta_7 \text{CSPP}_i + \beta_8 \text{Financial crisis}_i + \beta_9 \text{Sovereign debt crisis}_i + \beta_{10} \text{Country risk}_i + \beta_{11} \text{Rated}_i + \beta_{12} \text{Rating*rated}_i + \beta_{13} \text{Time to maturity}_i + \beta_{14} \text{Risk free rate}_i + \beta_{15} \text{EUSA5y-Libor3M}_i + \beta_{16} \text{Volatility}_i + \beta_{17} \text{Log GDP}_i + \beta_{18} \text{Government debt}_i + \beta_{19} \text{Number of banks}_i + \beta_{20} \text{Log transaction size}_i + \beta_{21} \text{Tranche to tansaction}_i + \beta_{22} \text{Fixed rate}_i + \beta_{23} \text{Currency risk}_i + \beta_{24} \text{Callable}_i + \varepsilon_i$$

Our initial model allows to test our first 4 hypotheses; i.e., to measure the impact of asset purchase programmes adopted by the ECB on AS, CB and SB yields. We first run this model including each specific programme separately and then including all programmes in the same regression. Finally, this model will be re-estimated including the following variables as additional regressors (complete model): TLTRO, 3Y-LTRO, DraghiSpeech and 0% Deposit. The dependent variable is the bond yield, in basis points, and the independent variables are those presented and described in Table 10, which gives an indication of the variables and their expected sign, taking into consideration the existing empirical literature. In order to test hypothesis 5, we will re-estimate our complete model for sub-samples analysing the impacts of the ECB programmes and liquidity provisions separately for bonds issued in PIIGS (Portugal, Ireland, Italy, Greece,

Spain), Germany and non-Germany. Finally, robustness checks are conducted comparing the models.

5.1. Regression Results

This section presents the results for the different models and regressions. First, we analyse the impact of the ECB asset purchase programmes on bond yields. Second, we investigate if with the inclusion of liquidity provisions (TLTRO, 3Y-LTRO, DraghiSpeech and 0% Deposit) and re-estimating our regressions for sub-samples (PIIGS, Germany and non-Germany) affect our conclusions regarding the hypotheses raised.

5.1.1. The impact of ECB Asset Purchase Programmes on bond Yields

Table 7 presents the results of the regression analysis of the impact of ECB asset purchase programmes on AS, CB and SB yields. Columns 1, 3, and 5 present the results of estimating our base model including programmes directly linked with the bond types being analysed. In models [1b], [2b], and [3b] we include all the ECB asset purchase programmes. For AS bonds – models [1a] and [1b] – we conclude that the ABSPP does not impact on AS bond yield, which means that the ABSPP hasn't been effective in meeting ECB objectives of lowering AS yields.[6] These results are contrary to what we expected and thus we do not validate H1.

[6] As both the ABSPP and CBPP3 started on September 2014 and are still open, we cannot analyse the impact of each programme separately.

Dependent variable: Yield to maturity (bps)	**[1a] AS**	**[1b] AS**	**[2a] CB**	**[2b] CB**	**[3a] SB**	**[3b] SB**
Independent variables:						
SMP		34.10		68.48***	101.87***	77.48***
		(0.589)		(0.000)	(0.000)	(0.000)
CBPP1		39.46	-33.14***	-37.10***		-15.59**
		(0.516)	(0.000)	(0.000)		(0.013)
CBPP2		48.27	71.64***	46.70***		33.30***
		(0.501)	(0.000)	(0.000)		(0.000)
ABSPP/CBPP3	-12.37	-32.11	-72.19***	-63.80***		-61.74***
	(0.682)	(0.226)	(0.000)	(0.000)		(0.000)
PSPP		69.22*		11.06	-82.57***	-25.16***
		(0.061)		(0.108)	(0.000)	(0.000)
CSPP		-20.48		37.94***		1.50
		(0.584)		(0.000)		(0.753)
Financial crisis	64.42	44.17	89.31***	99.08***	28.49***	37.10***
	(0.163)	(0.531)	(0.000)	(0.000)	(0.000)	(0.000)
Sovereign debt crisis	-64.02	-101.19**	62.91***	18.89***	-30.50***	-17.45**
	(0.194)	(0.028)	(0.000)	(0.000)	(0.000)	(0.030)
Country risk	-8.66	-7.35	3.83***	7.53***	22.02***	19.80***
	(0.173)	(0.249)	(0.002)	(0.000)	(0.000)	(0.000)
Rated	-53.5***	-54.22***	-6.19**	-8.51***	-13.77**	-19.22***
	(0.007)	(0.006)	(0.021)	(0.002)	(0.015)	(0.000)
Rated*rating	18.05***	18.01***	1.40***	1.80***	4.19***	5.18***
	(0.000)	(0.000)	(0.004)	(0.000)	(0.004)	(0.000)
Time to maturity	0.30	0.19	6.75***	6.80***	4.00***	4.06***
	(0.584)	(0.712)	(0.000)	(0.000)	(0.000)	(0.000)
Risk free rate	0.12	0.14	0.97***	0.95***	0.60***	0.62***
	(0.346)	(0.332)	(0.000)	(0.000)	(0.000)	(0.000)
EUSA5y-Libor3M	0.62***	0.61***	0.70***	0.63***	0.46***	0.51***
	(0.005)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	-1.10	-1.04	1.48***	1.11***	1.05***	1.11***
	(0.351)	(0.443)	(0.000)	(0.000)	(0.000)	(0.000)
Log GDP	-462.09***	-450.94***	73.76***	62.64***	-23.81***	-19.08**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.018)
Government debt	1.51*	1.67*	0.37*	0.29	-0.85***	-0.67***
	(0.078)	(0.052)	(0.057)	(0.125)	(0.000)	(0.000)
Number of banks	0.15	1.40	-3.15***	-2.94***	1.90***	1.80***
	(0.975)	(0.770)	(0.000)	(0.000)	(0.000)	(0.000)
Log transaction size	-16.83*	-17.89**	8.17***	8.26***	-11.92	-11.56***
	(0.068)	(0.044)	(0.000)	(0.000)	(0.000)	(0.000)
Tranche to transaction	-0.61	-2.64	67.53***	63.89***	-30.96*	-23.09
	(0.970)	(0.870)	(0.000)	(0.000)	(0.082)	(0.185)
Fixed rate	16.87	18.58	-72.12***	-72.21***	171.71***	169.49***
	(0.414)	(0.349)	(0.000)	(0.000)	(0.000)	(0.000)
Currency risk	-38.06**	-34.79**	-33.11***	-34.34***	17.54**	18.93**
	(0.033)	(0.050)	(0.000)	(0.000)	(0.049)	(0.035)
Callable	5.02	6.16	20.37***	19.96***	42.87**	41.76**
	(0.744)	(0.684)	(0.000)	(0.000)	(0.015)	(0.018)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1.477	1.477	12.989	12.989	8.958	8.958
Adjusted R^2	0.50	0.50	0.62	0.63	0.67	0.68

Table 7: Regression analyses of the impact of ECB asset purchase programmes on bond yields

Notes: Table 7 presents the results of OLS regression analyses of the impacts of ECB asset purchase programmes on Asset Securitization (AS), Covered Bond (CB) and Sovereign Bond (SB) yields. The dependent variable is the yield to maturity of the bond at issue in basis points. SMP is equal to 1 if the bond was issued during the securities market programmes 1 and 2 (from May 10, 2010 through September 6, 2012), and 0 otherwise. CBPP 1 is equal to 1 if the bond was issued during the first European Covered Bond Purchase Programme (from May 7, 2009 through June 30, 2010), and 0 otherwise. CBPP2 is equal to 1 if the bond was issued during the second European

Covered Bond Purchase Programme (from October 6, 2011 through October 31, 2012), and 0 otherwise. CBPP3 is equal to 1 if the bond was issued during the third European Covered Bond Purchase Programme (from September 4, 2014 through December 31, 2016), and 0 otherwise. ABSPP is equal 1 if the bond was issued during the European Asset-Backed Securities Purchase Programme (from after September 4, 2014 to December 31, 2016), and 0 otherwise. PSPP is an equal 1 if the bond was issued during the European Public Sector Purchase Programme (from after January 22, 2015 to December 31, 2016), and 0 otherwise. CSPP is equal to 1 if the bond was issued during the European Corporate Sector Purchase Programme (from March 10, 2016 to the final date of our study December 31, 2016), and 0 otherwise. Financial crisis that takes the value 1 if the issue date belongs to the 2007-2008 financial crisis (from September 15, 2008 through April 23, 2010), and 0 otherwise. Sovereign debt crisis takes the value 1 if the issue date belongs to the European sovereign debt crisis (April 24, 2010 through December 31, 2016), and 0 otherwise. Country risk is the S&P's country credit rating at closing date; the rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=22. Rated equal to 1 if the bond has a credit rating from S&P or Moody's and 0 otherwise. Rated*Rating represents the interaction between rated and credit rating. Time to Maturity is the maturity of the bond instrument in years. Risk free rate is the yield on a three-month German Treasury bill. EUSA5y-Libor3M is the difference between the five-year Euro swap rate and the 3-month Libor rate. Volatility is presented by The Chicago Board Options Exchange Volatility Index (VIX). Log GDP is the logarithm of yearly GDP for each country. Government Debt is the quarterly local government consolidated gross debt as a percentage of GDP. Number of banks is the number of financial institutions participating in the transaction. Log transaction size is the logarithm of the bond transaction size. Tranche to transaction represents the ratio of the tranche size to the transaction size. Fixed rate is equals to 1 if the bond has a fixed coupon rate, and 0 otherwise. Currency risk equals 1 for bonds denominated in a different currency than that of the country where the bank is headquartered, and 0 otherwise. Callable equal to 1 if the bond can be redeemed before the maturity date, and 0 otherwise. ***, ** and * indicates that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors clustered by transaction.

We find that the inclusion of other asset purchase programmes than the ABSPP – model [1b] versus model [1a] – does not change the coefficients sign and significance. Model [1b] shows that while the SMP, CBPP1, CBPP2 and CSPP do not affect significantly AS bond yields the PSPP has a positive impact in AS bond yield, since the PSPP dummy variable is an associated with a significant 69.22 bps increase on AS bond yields. So, none of the ECB asset purchase programmes has contributed to easing funding conditions for Euro area banks when issuing AS bonds. Models [1a] and [1b] show that the following variables do not affect AS bond yield: financial crisis, country risk, time to maturity, risk free rate, volatility, number of banks, tranche to transaction, fixed rate and callable. The results for financial crisis, volatility and callable contradicts the results from

previous literature. Regarding financial crisis, we expected a significant positive relationship between AS bond yield and financial crisis. This result can be explained by the fact that during the financial crisis, the number AS bonds in study for some countries is very small.

Regarding sovereign debt crisis variable, while model [1a] shows an insignificant impact, in model [1b] we find that this dummy variable is associated with a 101.19 bps decrease in yields, which is contrary to what we expected. This can be explained by the fact that only transactions collateralized by pools of assets with higher credit quality were structured during the sovereign debt crisis period, which might have mitigated the effect of the crisis.

In both models, as we expected, results show that rated AS bonds by S&P and/or Moody's have lower yields and the higher the credit risk the higher the yield to maturity. Models [1a] and [1b] show that the slope of the Euro swap curve increases AS yield to maturity by 0.62 bps and 0.61 bps, respectively. This contradicts what was expected based on the existing literature, since we expected that a sharper euro yield curve reduces bond yields because it might be a sign of expectation of economic growth and better performances.

The logarithm of GDP impacts negatively the yield to maturity by -462.09 bps and -450.94 bps in models [1a] and [1b], respectively. Moreover, the level of government debt has a positive impact of 1.51 bps and 1.67 bps, while the Log transaction size decreases AS bond yield in -16.83 bps and -17.89 bps, respectively. Finally, currency risk has a negative impact on AS bond yield, which is contrary to what we expected based on empirical literature.

For CB - models [2a] and [2b] - was analysed the impact of CBPP 1, 2 and 3 on CB yields to maturity as this programmes has the goal to decrease CB yields. Model [2b] is equal to model [2a], however it includes the impacts of all ECB programmes together in order to understand if the impact of CBPP1, 2 and 3 changes with the inclusion of the other programmes. Also, it allow us to analyse

the impact of programmes with the goal of decrease other types of bonds costs on CB bonds yields. Provided that, regressions [2a] and [2b] are useful to test H2. Both regressions provide information that CBPP1 decreases CB yields on -33.14 bps and -37.10 bps. Also, CBPP2 increases CB yields on 71.64 and 47.70 bps and CBPP3 decreases CB yields on -72.19 bps and -63.80 bps with 1% significance level. As in our models we use dummy variables for the programmes and ABSPP and CBPP3 started both on September 2014 and still exists we can't separate its impact. So, the impact of CBPP3 includes the impact of both because for CB ABSPP variable was eliminated because of multicollinearity. Additionally, regression [2b] inform that SMP has a positive impact on CB of 68.48 bps, and CSPP 37.94 bps for 1% significance level. It was verified that PSPP has an insignificant impact on CB. The results for SMP and PSPP contradicts what was expected from previous literature. In the case of SMP previous empirical studies found that this programme decreased CB spreads. So, it was expected a decrease on yields. The previous studies for PSPP found a positive relationship with bonds spread. So, it was expected an increase on yields. Resuming, the programmes that helped to achieve the ECB goal of decrease funding conditions, in the case of CB, were CBPP1 and CBPP3 (CBPP3 includes the impact form ABSPP). However, the CBPP3 gave the highest contribution. So, H2 is not true for CBPP2.

Regressions [2a] and [2b] show that financial crisis and sovereign debt crisis increased CB yield to maturities for 1% significance level. Regression [2a] express an increase caused by financial crisis of 89.31 bps and sovereign debt crisis of 62.91 bps and [2b] shows an increase caused by financial crisis of 99.08 bps and sovereign debt crisis of 18.89 bps. It is possible to conclude that financial crisis contributed more for the increased of CB yields than sovereign crisis. Observing both regressions country risk impacts positively CB on 3.83 bps and 7.53 bps for 1% significance level. The fact that a bond being rated by S&P and Moody's impacts negatively CB on -6.19 bps and -8.51 bps with 5% significance on [2a]

and 1% significance on [2b]. Additionally, the interaction between a rated bond and its credit rating (Rated*rating) increases CB yields by 1.40 bps and 1.80 bps. Moreover, time to maturity impacts CB positively by 6.75 bps and 6.80 bps for 1% significance level. On regressions [2a] and [2b] the risk free rate increases CB yields on 0.97 bps and 0.95 bps and the slope of Euro swap curve increases CB yields on 0.70 bps and 0.63 bps. The results for risk free rate and Euro swap curve contradicts the previous literature. For risk, free rate was expected a negative impact since higher yields mean better economic conditions and thus lower probabilities of default. For Euro swap curve it was expected a negative relationship because a sharper Euro yield curve reduce bond yields since it represents a positive expectation on economic growth. Volatility increases, as expected, the CB yields on 1.48 bps and 1.11 bps for 1% significance level. The logarithm of GDP affects positively yield to maturities of CB by 73.76 bps and 62.64 bps for 1% significance level.

Government debt increase CB yield to maturities on regression [2a] by 0.37 bps for 10% significance level and its insignificant on regression [2b]. The number of banks impacts negatively CB on -3.15 and -2.94 bps for 1% significance level. The logarithm of transaction size increases 8.17 bps and 8.26 bps CB yields 1% significance level. The results for number of banks and logarithm of transaction size contradict what was expected from previous literature. Regarding the number of banks, it was expected that on CB a higher number of banks increase funding costs. Looking to logarithm of transaction size it was expected that the higher the transaction size the lower the yields and spreads. Furthermore, tranche to transaction impacts positively CB on 67.53 and 63.89 bps for 1% significance level. Fixed rate has a negative impact on CB of -72.12 and -72.21 for 1% significance level. This fixed rate result contradicts the previous literature. It was expected a positive impact because on bonds with fixed rates usually investors require a higher compensation. The issuer pays a higher yield and is

protected from the interest rates increase. Furthermore, currency risk impacts negatively CB on -33.11 and -34.34 bps for 1% significance level. The results for currency risk contradicts what was expected according to previews literature. According to previous studies, it was expected that issues exposed to currency risk will have higher yields. Finally, for CB the fact that a bond being callable impacts positively CB on 20.37 bps and 19.96 bps for 1% significance level.

For SB, in regression [3a] we analyse the impact of SMP and PSPP on SB yield to maturities. Model [3b] is equal to model [3a], including the impacts of all ECB programmes together in order to understand if the impact of SMP and PSPP changes with the inclusion of the remaining programmes. Also, it allow us to analyse the impact of programmes which its goal is to decrease other types of bond funding costs. So, regressions [3a] and [3b] are important to test the third and fourth hypotheses.

Both regressions [3a] and [3b] allow us to conclude that SMP increases SB yields and its impact was 101.87 bps and 77.48 bps, respectively. The results for SMP are contrary to what was expected from previous literature and thus do not validate H4. Contrary, as expected, PSPP decreased SB yield to maturities by -82.57 bps on regression [3a] and -25.16 on regression [3b]. These results support H3. Additionally, regression [3b] allow us to verify that, as expected, CBPP1 and CBPP3 decreased SB yields by -15.59 bps and -61.74 bps, respectively. This confirms the existence of a bank and sovereign risk relationship because CBPPs by reducing CB yields have, simultaneously a significant negative impact on SB yields. By contrast, the CBPP2 has a positive impact of 33.30 bps on SB yields and the impact of CSPP is insignificant. The results for CBPP2 contradicts the previews literature: according to previous studies it was expected a negative impact on funding costs. In short, only CBPP1, CBPP3, ABSPP and PSPP helped to decrease SB yields.

Regressions [3a] and [3b] show that financial crisis increased SB yields by 28.49 bps and 37.10 bps, respectively. By contrast, sovereign debt crisis impacts negatively SB yields in both models. This decrease for sovereign debt crisis contradicts what was expected when considering previous studies. It was expected a positive relationship because this crisis increased debt risk in European countries. It happens because all of the ECB's asset purchase programs contributed to a reduction in yields in this period. Observing both models, country risk impacts positively SB on 22.02 bps and 19.80 bps. The fact that a bond being rated by S&P and Moody's impacts negatively SB on -13.77 bps and -19.22 bps. Additionally, the interaction between a rated bond and its credit rating (Rated*rating) increases SB yields by 4.19 bps and 5.18 bps for 1% significance level. The time to maturity of a bond impacts SB positively by 4.00 bps and 4.06 bps for 1% significance level. Furthermore, the risk free rate increases SB yields on 0.60 bps and 0.62 bps for 1% significance level. The slope of Euro swap curve increases SB yields on 0.46 and 0.51 bps for 1% significance level. So, this results for risk free rate and Euro swap curve contradicts the previous literature. For risk free rate, it was expected a negative impact since higher yields mean better economic conditions and thus lower probabilities of default. For Euro swap curve, it was expected a negative relationship because a sharper Euro yield curve reduce bond yields since it represents a positive expectation on economic growth.

Volatility increases SB yields on 1.05 and 1.11 bps for 1% significance level. The logarithm of GDP affects negatively yield to maturities of SB by -23.81 and -18.09 bps for 1% significance level on [3a] and 5% significance level on [3b]. Government debt decrease SB yield to maturities on regression [3a] by -0.85 bps for 1% significance level and -0.67 bps for 1% significance level on [2b]. The results for government debt contradicts the previous literature. More government debt means more risk associated with a country and consequently

was expected a higher yield. The number of banks impacts positively AS on 1.90 and 1.80 bps for 1% significance level. The logarithm of transaction size increases has an insignificant impact on SB observing regression [3a] and impacts negatively by -11.56 bps for 1% significance level when observing regression [3b]. Moreover, tranche to transaction impacts negatively SB on -30.96 for 10% significance level on regression [3a] and according to regression [3b] it has an insignificant impact. The results for tranche to transaction contradicts the existent literature because at an increase in tranche to transaction is associated an increase in risk for SB. The fact that a SB have a fixed rate has a positive impact of 171.71 bps and 169.49 bps for 1% significance level. Currency risk impacts positively SB on 17.54 bps and 18.93 bps for 5% significance level. Finally, the fact that a bond being callable impacts positively SB on 42.87 bps and 41.76 bps for 5% significance level.

5.1.2. Impact of ECB Programmes and Liquidity Provisions on Yield to Maturities.

Table 8 presents the results of the regression analysis of the impact of ECB programmes and liquidity measures on bond yields. Models [1b], [2b] and [3b] – were re-estimated including some ECB liquidity provision measures as additional regressors: *TLTRO, 3Y-LTRO, Draghi Speech and 0% deposit*. These regressions allow us to go deeply and understand how liquidity measures impacted yields. Moreover, we can check the robustness of our base model. So, it helps to verify if the previews results change with the inclusion of these variables. Regression [1c] is useful to test H1 and the results are the same as in model [1b] for many variables. However, in model [1c] the impact of the variable PSPP becomes insignificant. Finally, in regression [1c] we include the impact of 3Y-LTRO.

Dependent variable: Yield to maturity (bps)	**[1b] AS**	**[1c] AS**	**[2b] CB**	**[2c] CB**	**[3b] SB**	**[3c] SB**
Independent variables:						
SMP	34.10	-102.14	68.48***	46.29***	77.48***	53.85***
	(0.589)	(0.257)	(0.000)	(0.000)	(0.000)	(0.000)
CBPP1	39.46	9.47	-37.10***	-38.21***	-15.59**	-18.92***
	(0.516)	(0.877)	(0.000)	(0.000)	(0.013)	(0.003)
CBPP2	48.27	129.17	46.70***	61.53***	33.30***	46.31***
	(0.501)	(0.144)	(0.000)	(0.000)	(0.000)	(0.000)
ABSPP/CBPP3	-32.11	-23.66	-63.80***	-43.72***	-61.74***	-33.29***
	(0.226)	(0.378)	(0.000)	(0.000)	(0.000)	(0.000)
PSPP	69.22*	-128.00	11.06	-7.64	-25.16***	-54.42***
	(0.061)	(0.169)	(0.108)	(0.402)	(0.000)	(0.000)
CSPP	-20.48	-32.64	37.94***	34.00***	1.50	-4.90
	(0.584)	(0.389)	(0.000)	(0.000)	(0.753)	(0.320)
Financial crisis	44.17	77.12	99.08***	101.67***	37.10***	44.43***
	(0.531)	(0.277)	(0.000)	(0.000)	(0.000)	(0.000)
Sovereign debt crisis	-101.19**	77.04	18.89***	43.09***	-17.45**	10.43
	(0.028)	(0.426)	(0.000)	(0.000)	(0.030)	(0.301)
Country risk	-7.35	-7.90	7.53***	7.56***	19.80***	19.79***
	(0.249)	(0.232)	(0.000)	(0.000)	(0.000)	(0.000)
Rated	-54.22***	-57.72***	-8.51***	-8.66***	-19.22***	-20.11***
	(0.006)	(0.002)	(0.002)	(0.001)	(0.000)	(0.000)
Rated*rating	18.01***	18.29***	1.80***	1.84***	5.18***	5.16***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Time to maturity	0.19	0.05	6.80***	6.81***	4.06***	4.06***
	(0.712)	(0.914)	(0.000)	(0.000)	(0.000)	(0.000)
Risk free rate	0.14	0.09	0.95***	0.94***	0.62***	0.60***
	(0.332)	(0.496)	(0.000)	(0.000)	(0.000)	(0.000)
EUSA5y-Libor3M	0.61***	0.53**	0.63***	0.62***	0.51***	0.46***
	(0.007)	(0.019)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	-1.04	-2.02	1.11***	1.04***	1.11***	0.79***
	(0.443)	(0.130)	(0.000)	(0.000)	(0.000)	(0.000)
Log GDP	-450.94***	-481.08***	62.64***	60.35***	-19.08**	-27.90***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.018)	(0.001)
Government debt	1.67*	1.84**	0.29	0.27	-0.67***	-0.66***
	(0.052)	(0.037)	(0.125)	(0.159)	(0.000)	(0.000)
Number of banks	1.40	2.42	-2.94***	-2.94***	1.80***	1.83***
	(0.770)	(0.582)	(0.000)	(0.000)	(0.000)	(0.000)
Log transaction size	-17.89**	-19.44**	8.26***	8.29***	-11.56***	-11.57***
	(0.044)	(0.020)	(0.000)	(0.000)	(0.000)	(0.000)
Tranche to transaction	-2.64	1.58	63.89***	63.74***	-23.09	-24.23
	(0.870)	(0.923)	(0.000)	(0.000)	(0.185)	(0.165)
Fixed rate	18.58	22.14	-72.21***	-72.27***	169.49***	170.36***
	(0.349)	(0.229)	(0.000)	(0.000)	(0.000)	(0.000)
Currency risk	-34.79**	-39.29**	-34.34***	-34.38***	18.93**	19.23**
	(0.050)	(0.027)	(0.000)	(0.000)	(0.035)	(0.032)
Callable	6.16	7.85	19.96***	19.95***	41.76**	40.75**
	(0.684)	(0.587)	(0.000)	(0.000)	(0.018)	(0.021)
TLTRO				-22.90**		-32.61***
				(0.019)		(0.000)
3Y-LTRO		-203.94**		-22.80***		-30.62***
		(0.020)		(0.001)		(0.000)
DraghiSpeech						58.22
						(0.151)
0% Deposit						54.49**
						(0.012)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,477	1,477	12,989	12,990	8,958	8,958
Adjusted R^2	0.50	0.51	0.63	0.63	0.68	0.68

Table 8: Regression analysis on the impact of ECB programmes and liquidity provisions on yield to maturities.

Notes: Table 8 presents the results of OLS regression analysis of the impacts of ECB programmes and liquidity provisions on Asset Securitization Bonds, Covered Bonds and Sovereign Bonds yield to maturities. The dependent variable is yield to maturity of the bond at issue in basis points. SMP is equal to 1 if the bond was issued during the securities market programmes 1 and 2 (from May 10, 2010 through September 6, 2012), and 0 otherwise. CBPP 1 is equal to 1 if the bond was issued during the first European Covered Bond Purchase Programme (from May 7, 2009 through June 30, 2010), and 0 otherwise. CBPP2 is equal to 1 if the bond was issued during the second European Covered Bond Purchase Programme (from October 6, 2011 through October 31, 2012), and 0 otherwise. CBPP3 is equal to 1 if the bond was issued during the third European Covered Bond Purchase Programme (from September 4, 2014 through December 31, 2016), and 0 otherwise. ABSPP is equal 1 if the bond was issued during the European Asset-Backed Securities Purchase Programme (from after September 4, 2014 to December 31, 2016), and 0 otherwise. PSPP is equal 1 if the bond was issued during the European Public Sector Purchase Programme (from after January 22, 2015 to December 31, 2016), and 0 otherwise. CSPP is equal to 1 if the bond was issued during the European Corporate Sector Purchase Programme (from March 10, 2016 to the final date of our study December 31, 2016), and 0 otherwise. Financial crisis takes the value 1 if the issue date belongs to the 2007-2008 financial crisis (from September 15, 2008 through April 23, 2010), and 0 otherwise. Sovereign debt crisis that takes the value 1 if the issue date belongs to the European sovereign debt crisis (April 24, 2010 through December 31, 2016), and 0 otherwise. Country risk is the S&P's country credit rating at closing date; the rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=22. Rated is equal to 1 if the bond has a credit rating from S&P or Moody's, and 0 otherwise. Rated*Rating represents the interaction between rated and credit rating. Time to Maturity is the maturity of the financial instrument in years. Risk free rate is the yield on a three-month German Treasury bill. EUSA5y-Libor3M is the difference between the five-year Euro swap rate and the 3-month Libor rate. Volatility is presented by The Chicago Board Options Exchange Volatility Index (VIX). Log GDP is the logarithm of yearly GDP for each country measured as sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Government Debt is the quarterly local government consolidated gross debt as a percentage of GDP. Number of banks is the number of financial institutions participating in the transaction. Log transaction size is the logarithm of the bond transaction size. Tranche to transaction represents the ratio of the tranche size to the transaction size. Fixed rate equals to 1 if the bond has a fixed coupon rate, and 0 otherwise. Currency risk equals 1 for bonds denominated in a different currency than that of the country where the bank is headquartered, and 0 otherwise. Callable equal to 1 if the bond can be redeemed before the maturity date, and 0 otherwise. ***, ** and * indicates that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors clustered by transaction.

This variable decreases AS bond yield maturities, as expected, by -230.94 bps. For CB, results in models [2b] and [2c] are basically the same, allowing us to validate H2.

We find a significant negative impact of TLTRO variables on CB yields. A similar impact was found for 3YLTRO variable.

Model [3c] shows the same results as model [3b] for variables capturing the impact of ECB purchase programmes on SB yields. In short, we find that, the variable sovereign debt crisis had a negative impact significant at 5% level on regression [2b] that passed to be insignificant on regression [2c]. Moreover, sovereign debt crisis occurred from 2010 to 2016, that is a long period and could distort the positive impact of the increase caused by sovereign debt crisis on the regression analysis. Additionally, this distortion could be caused by the fact that for some countries the number of observations for SB is small (in relation to H3 and H4). Finally, model [2c] shows the following results regarding the impact of variables capturing liquidity measures in SB yields: (i) variable TLTRO has an impact of -32.61 bps on SB yields; (ii) SB yields and 3Y-LTRO have a significant negative relationship; and (iii) while the dummy variable Draghi speech has an insignificant impact, the 0% deposit dummy has a significant positive impact on SB yields of 54.49bps.

5.1.3. The ECB Asset Purchase Programmes on PIIGS, Germany and non-Germany countries

Table 9 presents the results of the regression analysis of the impact of ECB programmes and liquidity measures on bonds yields considering the country of the issuer. So, the impacts will be studied separately for issuers domiciled in PIIGS, Germany and non-Germany countries. These regressions were used to compare the impact of ECB programmes and liquidity measures for central and peripheric European countries to test H5.

Dependent variable: Yield to maturity (bps)	**[1d] AS (PIIGS)**	**[1e] AS (Germany)**	**[1f] AS (Non-Germany)**	**[2d] CB (PIIGS)**	**[2e] CB (Germany)**	**[2f] CB (Non-Germany)**	**[3d] SB (PIIGS)**	**[3e] SB (Germany)**	**[3f] SB (Non-Germany)**
Independent variables:									
SMP	68.67	-209.63	-80.42	113.67***	-1.64	81.89***	112.08***	27.69***	59.40***
	(0.452)	(0.218)	(0.375)	(0.000)	(0.876)	(0.000)	(0.000)	(0.001)	(0.000)
CBPP1	129.18	-2.77	-20.58	-14.20	-36.26***	-52.38***	-5.28	-30.06***	-18.81
	(0.158)	(0.978)	(0.756)	(0.356)	(0.000)	(0.000)	(0.643)	(0.002)	(0.011)
CBPP2	71.14	254.76	115.67	77.90***	55.23***	60.10***	68.48***	5.40	53.64***
	(0.376)	(0.131)	(0.191)	(0.000)	(0.000)	(0.000)	(0.000)	(0.527)	(0.000)
ABSPP/CBPP3	-2.43	-21.78	-31.79	-91.56***	-14.91	-57.71***	-50.26***	-7.76	-41.85
	(0.945)	(0.697)	(0.310)	(0.000)	(0.330)	(0.001)	(0.003)	(0.549)	(0.001)
PSPP	-79.81	-126.00	-148.34	18.18	-22.11	2.14	-74.59***	-35.47**	-63.36***
	(0.357)	(0.494)	(0.139)	(0.149)	(0.116)	(0.850)	(0.000)	(0.013)	(0.000)
CSPP	73.49	-223.61***	22.48	30.66***	38.39***	25.64***	19.42***	25.54***	-9.74
	(0.197)	(0.001)	(0.600)	(0.005)	(0.001)	(0.000)	(0.009)	(0.000)	(0.106)
Financial crisis	-332.41***	-34.09	103.45	83.84***	99.85***	90.92***	89.30***	0.60	65.57***
	(0.006)	(0.757)	(0.212)	(0.000)	(0.000)	(0.000)	(0.000)	(0.969)	(0.000)
Sovereign debt crisis	-383.81**	178.50	33.52	43.80	58.69***	-9.44	73.11***	-44.96***	31.58***
	(0.028)	(0.371)	(0.758)	(0.188)	(0.000)	(0.588)	(0.001)	(0.005)	(0.010)
Country risk	0.12		-7.91	8.61		5.15	30.34***		18.02***
	(0.996)		(0.229)	(0.101)		(0.000)	(0.000)		(0.000)
Rated	-161.52***	-114.41***	-48.77**	-7.20	-8.74***	-7.71	-3.61	-9.77	-37.64***
	(0.001)	(0.001)	(0.029)	(0.403)	(0.000)	(0.371)	(0.837)	(0.167)	(0.000)
Rated*rating	26.22***	19.76***	18.91***	4.73***	1.53***	3.82***	2.19	3.30	5.37***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.001)	(0.278)	(0.284)	(0.001)
Time to maturity	-4.75***	-0.29	-0.05	7.42***	9.02***	4.59***	6.00***	4.37***	4.12***
	(0.004)	(0.655)	(0.923)	(0.000)	(0.000)	(0.00)	(0.000)	(0.000)	(0.000)
Risk free rate	-0.16	-0.18	0.12	0.85***	1.03***	0.74***	0.66***	0.72***	0.59***
	(0.609)	(0.544)	(0.444)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EUSA5y-Libor3M	0.12	1.70***	0.21	0.64****	0.69***	0.51***	0.59***	0.56***	0.45***
	(0.831)	(0.001)	(0.378)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Volatility	2.99	1.58	-2.92*	2.40***	1.01***	1.38***	1.90***	0.57	0.83***
	(0.273)	(0.546)	(0.062)	(0.000)	(0.000)	(0.000)	(0.000)	(0.162)	(0.001)
Log GDP	-175.21	-508.01**	-462.05***	28.95	76.67***	60.67***	-13.93	6.18	-42.93***
	(0.121)	(0.020)	(0.000)	(0.100)	(0.000)	(0.000)	(0.244)	(0.802)	(0.000)
Government debt	3.45	-5.07	2.65**	-0.05	0.38	0.76**	-1.30***	0.38	-0.23
	(0.121)	(0.620)	(0.012)	(0.914)	(0.564)	(0.011)	(0.000)	(0.758)	(0.234)
Number of banks	-14.99	-5.90	1.06	0.72	-3.18***	-0.99	2.39***	4.00***	0.87
	(0.118)	(0.495)	(0.828)	(0.444)	(0.000)	(0.197)	(0.001)	(0.000)	(0.079)
Log transaction size	-14.63	-11.69	-16.95*	0.98	6.23***	5.99	-10.85***	-9.77***	-12.01***
	(0.246)	(0.355)	(0.087)	(0.592)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tranche to transaction	76.54*	-58.05	14.96	51.08***	41.73***	51.83***	-75.22**	20.29	-33.49*
	(0.064)	(0.092)	(0.444)	(0.000)	(0.001)	(0.001)	(0.044)	(0.604)	(0.076)
Fixed rate	84.04	90.30***	8.03	-7.75	-26.23*	-106.63***	27.98	7.62	206.07***
	(0.129)	(0.007)	(0.699)	(0.783)	(0.083)	(0.000)	(0.325)	(0.732)	(0.000)
Currency risk	-80.81	16.92	-54.34***	5.54	-38.45***	-31.19***	-42.69***	20.45	12.31
	(0.118)	(0.603)	(0.009)	(0.888)	(0.000)	(0.000)	(0.008)	(0.224)	(0.231)
Callable	42.76	30.50	1.50	30.02***	11.60***	29.57***	47.54	-38.00**	56.72
	(0.110)	(0.239)	(0.930)	(0.005)	(0.000)	(0.001)	(0.195)	(0.035)	(0.153)
TLTRO				-45.66*	-4.00	-45.54***	-98.86***	3.56	-46.51
				(0.099)	(0.733)	(0.005)	(0.000)	(0.663)	(0.000)
3Y-LTRO	-78.38	-226.87	-208.15**	-2.58	-37.62***	-14.73	-60.89***	-18.19**	-39.66***
	(0.285)	(0.184)	(0.030)	(0.855)	(0.000)	(0.120)	(0.000)	(0.023)	(0.000)
DraghiSpeech							12.35		33.71
							(0.482)		(0.417)
0% Deposit							16.92		35.22
							(0.494)		(0.123)
Country fixed effects	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Number of observations	245	306	1,171	1,159	9,277	3,712	2,931	2,217	6,741
Adjusted R^2	0.56	0.64	0.50	0.78	0.68	0.58	0.68	0.78	0.66

Table 9: Regression analysis of the impact of ECB programmes and liquidity provisions on bond yields separating in subsamples for: PIIGS, Germany and non-Germany

Notes: Table 9 presents the results of OLS regression analysis of the impacts of ECB programmes and liquidity provisions on Asset Securitization Bonds, Covered Bonds and Sovereign Bonds yield to maturities separating in subsamples for: PIIGS, Germany and non-Germany. The dependent variable is yield to maturity of the bond at issue in basis points. SMP is equal to 1 if the bond was issued during the securities market programmes 1 and 2 (from May 10, 2010 through September 6, 2012), and 0 otherwise. CBPP 1 is equal to 1 if the bond was issued during the first European Covered Bond Purchase Programme (from May 7, 2009 through June 30, 2010), and 0 otherwise. CBPP2 is equal to 1 if the bond was issued during the second European Covered Bond Purchase Programme (from October 6, 2011 through October 31, 2012), and 0 otherwise. CBPP3 is equal to 1 if the bond was issued during the third European Covered Bond Purchase Programme (from September 4, 2014 through December 31, 2016), and 0 otherwise. ABSPP is equal 1 if the bond was issued during the European Asset-Backed Securities Purchase Programme (from after September 4, 2014 to December 31, 2016), and 0 otherwise. PSPP is equal 1 if the bond was issued during the European Public Sector Purchase Programme (from after January 22, 2015 to December 31, 2016), and 0 otherwise. CSPP is equal to 1 if the bond was issued during the European Corporate Sector Purchase Programme (from March 10, 2016 to the final date of our study December 31, 2016), and 0 otherwise. Financial crisis that takes the value 1 if the issue date belongs to the 2007-2008 financial crisis (from September 15, 2008 through April 23, 2010), and 0 otherwise. Sovereign debt crisis that takes the value 1 if the issue date belongs to the European sovereign debt crisis (April 24, 2010 through December 31, 2016), and 0 otherwise. Country risk is the S&P's country credit rating at closing date; the rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=22. Rated is equal to 1 if the bond has a credit rating from S&P or Moody's, and 0 otherwise. Rated*Rating represents the interaction between rated and credit rating. Time to Maturity is the maturity of the financial instrument in years. Risk free rate is the yield on a three-month German Treasury bill. EUSA5y-Libor3M is the difference between the five-year Euro swap rate and the 3-month Libor rate. Volatility is presented by The Chicago Board Options Exchange Volatility Index (VIX). Log GDP is the logarithm of yearly GDP for each country measured as sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Government Debt is the quarterly local government consolidated gross debt as a percentage of GDP. Number of banks is the number of financial institutions participating in the transaction. Log transaction size is the logarithm of the bond transaction size. Tranche to transaction represents the ratio of the tranche size to the transaction size. Fixed rate is equal to 1 if the bond has a fixed coupon rate, and 0 otherwise. Currency risk equals 1 for bonds denominated in a different currency than that of the country where the bank is headquartered. Callable equal to 1 if the bond can be redeemed before the maturity date, and 0 otherwise. ***, ** and * indicates that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors clustered by transaction.

Analysing the results for AS bonds (models [1d], [1e] and [1f])we find that SMP, CBPP1, CBPP2 ABSPP and PSPP have an insignificant impact on the three regressions. Furthermore, CSPP decreases AS bond yields for issuers located in Germany only by 223.61 bps. In short, for AS we do not validate H5.

Analysing the results for CB when separating the sample for issuers domiciled in PIIGS [2d], Germany [2e] and non-Germany [2f] countries, we find that both CBPP2 and CSPP increase significantly CB yields for all regressions. Observing model [2d], [2e] and [2f] the impact of CBPP2 is higher for PIIGS and lower for Germany. Also, the impact of CSPP is higher for Germany and lower for non-Germany countries. Additionally, SMP and ABSPP have a significant impact for PIIGS and non-Germany countries. Despite the impact of SMP is positive, yields and ABSPP dummy variable have a significant negative relationship. Finally, the CBPP1 decreases CB yields for issuers belonging to Germany [2e] countries. Despite the results hold for non-Germany countries [2f], the impact of CBPP1 on CB yields issued in PIIGS is insignificant.

In summary, H5 is true only for CBPP3 and TLTRO because there is a higher and negative impact of these programmes on PIIGS than on core countries.

Finally, regarding SB we find that the SMP has a positive impact on yields for the three regressions. The impact is higher in regression [3d] than in [3f]. By contrast, the PSPP has a negative impact on yields for three regressions. Again, the impact is higher in model [3d] than in [3f]. Additionally, the CBPP1 decreases SB yields for Germany only while the CBPP3 decreases SB yields for PIIGS. Furthermore, SB yields and CBPP2 dummy variable have a significant positive relationship for SB yields in models [3d] and [3f]. Finally, the CSPP increases SB yields in both models [3d] and [3e], but not for SB issued by non-Germany countries. This result is counter-intuitive and is an interesting issue for future research.

In summary, we validate H5 for PSPP and 3Y-LTRO and not for the other programmes. There is a higher and negative impact of these programmes on PIIGS than on core countries.

6. Conclusion

In this thesis, we perform univariate and regression analyses of the impact of the ECB asset purchase programmes and liquidity provisions on banks and countries cost of borrowing. In order to do so, we use a sample of 23,525 bonds issued between January 1, 2000 and December 31, 2016, of which 1,477 were classified as asset securitization bonds, 12,989 as covered bonds, and 8,959 as sovereign bonds.

The results show, for asset securitization bonds, that the ABSPP doesn't impact on yields, what contradicts the previous literature. Moreover, SMP, CBPP1, CBPP2 and CSPP impacts on AS bonds are insignificant. Only the PSPP has a positive impact on asset securitization bond yields. In short, for Eurozone none of the ECB programmes helped to decrease AS yields, with the exception of CSPP that decreases AS bond yields for banks domiciled in Germany.

For CB, we verify that CBPP1 and 3 decreases CB yields. Also, CBPP2 and SMP and CSPP increase CB yields. Our results also show that the PSPP has an insignificant impact on CB. In summary, the programmes that achieved the ECB goal of funding cost reduction were CBPP1 and CBPP3, with CBPP3 giving the highest contribution.

For SB, the SMP increases bonds yields. The results for SMP contradicts what was expected from previous literature. Moreover, as expected, PSPP decreases SB yields. Also, CBPP1 and 3 helps to decrease SB yields. So, these CBPPs also help to decrease SB yields, which provide evidence regarding the existence of a bank and sovereign risk relationship. When banks have better conditions, it helps countries getting better conditions too. By contrast when banks are in trouble the government needs to help them. Moreover, CBPP2 has a positive impact on yields and the impact of CSPP is insignificant. In short, the programmes CBPP1,

CBPP3 (together with ABSPP) and PSPP help to decrease SB yields. The CBPP3 together with ABSPP contribute with the highest impact.

Considering the differences of the impacts of the programmes on core and peripherical European countries, in the case of AS bonds, the only programme that impacts the yields has its impact only significant for central countries. For CB, the impacts of SMP, CBPP2, CBPP3 and TLTRO are higher for peripherical countries. However, only CBPP3 and TLTRO have a negative impact and verify hypothesis 5. Finally, for SB the impacts of SMP, CBPP2, PSPP, TLTRO and 3Y-LTRO are higher for peripherical countries. However, only PSPP and 3Y-LTRO have a negative impact on SB yield and verify hypothesis 5.

In practice, it's important to understand how these programmes are helping ECB to achieve its goals, namely on the decrease of funding costs in European countries. In fact, we verified that bond yields are greater for peripherical countries than for central countries. However, its visible a decrease on bond yields, so it would be interesting for future investigation to examine how this decrease on yields is impacting inflation and contributing to achieve the target inflation rate of 2%. Moreover, it could also be a future investigation the study of the impact of ECB programmes on corporate bonds. Furthermore, it would be also interesting study the impact of the ECB programmes in United States bonds.

7. References

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8. Attachments

8.1. Attachment 1 – Definition of variables

Variable	Description	Empirical Literature	Expected Sign			Findings		
			AS	CB	SB	AS	CB	SB
Dependent Variable								
Yield to maturity	Yield to maturity of the bond at issue in basis points.							
Independent Variables								
Microeconomic independent variables								
Log transaction size	Logarithm of the bond transaction size. Transaction size is the volume of the transaction of a given bond in Euros.	Vink and Thibeault (2008) ǀ Prokopczuk *et al.* (2013) ǀ Gürtler and Neelmeier (2016)	-/I	-/I	-/I	-/I	+/I	-/I
Tranche size	Represents the amount of the tranche. Tranche size is converted into Euro millions when necessary.	Maris and Segal (2002) ǀ Vink and Thibeault (2008) ǀ Sorge and Gadanecz (2008)ǀ Buscaino *et al.* (2012)	-	-	-			
Tranche to transaction	Ratio of the tranche size to the transaction size of a given bond issue.	Vink and Thibeault (2008)	-/I	+	**+**	+/I	+	-/I
Time to maturity	Maturity of a bond, in years.	Vink and Thibeault (2008) ǀ Sorge and Gadanecz, (2008) ǀ Gerlach *et. al.* (2010) ǀ Gürtler and Neelmeier (2016)	?	+	+/I	-/I	**+**	+
Number of tranches	Number of tranches per transaction.	Firla-Cuchra and Jenkinson (2006) ǀ Vink and Thibeault (2008)	+/I	-	-			
Number of banks	Number of financial institutions contributing in the transaction.	Sorge and Gadanecz (2008) ǀ Vink and Thibeault (2008) ǀ Nadauld and Weisbach (2012)	-/I	+	?	I	-/I	+/I

Rated	Dummy equal to 1 if the bond has a credit rating from S&P or Moody's and 0 otherwise.	Ammer and Clinton (2004) ǀ Hu and Cantor (2006) ǀ Vink and Thibeault (2008) ǀ Sorge and Gadanecz (2008) ǀ Buscaino *et al.* (2012) ǀ Prokopczuk *et al.* (2013) ǀ Gürtler and Neelmeier (2016)	-	?	?	-	-/I	-/I
Rating*rated	Represents the interaction between rated and credit rating. Credit rating is the S&P and Moody's rating at bond issuance; the rating is converted as follows: 1=best (from AAA to A+); 2=investment grade (from A to BBB−); 3=speculative (from BB+ to BB); 4=poor (from BB−to CC); and 5=default.		+	+	+	+	+	+/I
Fixed rate	Dummy equal to 1 if a loan or bond is fixed price and 0 otherwise.	Vink and Thibeault (2008)	+/I	+	+	+/I	-/I	+/I
Currency risk	Dummy variable that takes the value 1 for bonds that are denominated in a currency different from the currency in the deal's nationality.	Vink and Thibeault (2008)	+/I	+	+	-/I	-/I	?
Callable	Dummy equal to 1 if the bond has a call option and 0 otherwise.	Fabozzi and Kothari (2007)	+	+	+	I	+	?
Credit rating	Credit Rating is the S&P and Moody's rating at bond issuance. The rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=22.	Gabbi and Sironi (2005) ǀ Vink and Thibeault (2008) ǀ Sorge and Gadanecz (2008) ǀ Zähres (2012)ǀ Gatti *et al.* (2013) ǀ Zaghini (2014)	+	+	+			
Management fees	Total management fee received for participating in the management group in basis points.	Gabbi and Sironi (2005)	+	+	+			
U.K. borrowers	Dummy equal to 1 if the bank issuer is located in the U.K. and 0 otherwise.	Prokopczuk *et al.* (2013)	?	+/I	?			
Independent variables:								
Macroeconomic independent variables								
Country risk	S&P's country credit rating at closing date. The rating isg converted as follows: AAA=1, AA+=2, and so on until D=22.	Zaghini and Aviram Levy (2010) ǀ Andrea Zaghini (2014) ǀ Gibson *et al.* (2016) ǀ Gürtler and Neelmeier (2016)	+/I	+/I	+	I	+/I	+
Risk free rate	Is the yield on a 3-month German Treasury bill at the time of issuing the bonds.	Eichengreen and Mody (1998) ǀ Kamin and Von Kleist (1999) ǀ Collin-Dufresne *et al.* (2001) ǀ Altavilla *et al.* (2015)	-/I	-	-	I	+	+
EUSA5y-Libor3M	Is the difference between the five-year Euro swap rate and the 3-month Libor. Represents the slope of Euro swap curve.	Longstaff and Schwarz (1995) ǀ Hu and Cantor (2006) ǀ Sorge and Gadanecz (2008) ǀ Fontana and Scheicher (2010)	-/I	-/I	-	+/I	+	+
Volatility	Represented by the Chicago Board Options Exchange Volatility Index (VIX).	Fabozzi and Kothari (2007) ǀ Gagnon *et al.* (2011a, 2011b) ǀ Szczerbowicz (2015) ǀ Gürtler and Neelmeier (2016)	+	+	+	-/I	+	+/I

Log GDP	Logarithm of GDP. GDP for each country and year was measured as sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It was calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data was transformed to euros.	Matei and Cheptea (2013)	?	?	-	-/I	+/I	-/I
Government debt	Quarterly local government consolidated gross debt as a percentage of GDP.	Matei and Cheptea (2013) ǀ Gibson *et al.* (2016)	+	+	+	+/I	+/I	-/I
0% Deposit	Dummy equal to 1 if the bond was issued during the day of the announcement of 0% deposit rate (July 5, 2012) by ECB and zero otherwise.	Szczerbowicz (2015)	-	-	-			+/I
Draghi Speech	Dummy equal to 1 if the bond was issued on the day of Draghi speech (July 26, 2012) and zero otherwise.	Szczerbowicz (2015) ǀ Gibson *et al.* (2016)	-	-	-			+/I
SMP	Dummy equal to 1 if the bond was issued during the securities market programmes 1 and 2 (from May 10, 2010 through September 6, 2012) and zero otherwise.	Szczerbowicz (2015) ǀ Gibson *et al.* (2016) ǀ Hofmann et al. (2016)	?	-	-	I	+/I	+
TLTRO	Dummy equal to 1 if the bond was issued during the targeted long-term refinancing operations (from June 5, 2014 to the end date of our study December 31, 2016) and zero otherwise.	Heam *et al.* (2015) ǀ Gerba and Macchiarelli (2016)	-	-	-/I		-/I	-/I
3Y-LTRO	Dummy equal to 1 if the bond was issued during the Three-Year Long-Term Refinancing Operations (from December 8, 2011 to February 29, 2015) and zero otherwise.	Szczerbowicz (2015) ǀ Hofmann *et al.* (2016)	-	-	+	-/I	-/I	-/I
CBPP1	Dummy equal to 1 if the bond was issued during the first European Covered Bond Purchase Programme (from May 7, 2009 through June 30, 2010) and 0 otherwise.	Beirne *et al.* (2011) ǀ Schuller (2013) ǀ Szczerbowicz (2015) ǀ Heam *et al.* (2015) ǀ Gibson *et al.* (2016) ǀ Gürtler and Neelmeier (2016) ǀ Hofmann *et al.* (2016)	?	-	-	I	-/I	-/I
CBPP2	Dummy equal to 1 if the bond was issued during the second European Covered Bond Purchase Programme (from October 6, 2011 through October 31, 2012) and 0 otherwise.		?	-	-	I	+	+/I
CBPP3	Dummy equal to 1 if the bond was issued during the third European Covered Bond Purchase Programme (from September 4, 2014 through December 31, 2016) and 0 otherwise.		?	-	-	I	-/I	-/I
ABSPP	Dummy equal 1 if the bond was issued during the European Asset-Backed Securities Purchase Programme (from after September 4, 2014 to December 31, 2016) and zero otherwise.	Heam *et al.* (2015) ǀ Hofmann *et al.* (2016) ǀ Blattner *et al.* (2016)	-	+	-	I	-/I	-/I
PSPP	Dummy equal 1 if the bond was issued during the European Public Sector Purchase Programme (from after January 22, 2015 to December 31, 2016) and zero otherwise.	Hofmann *et al.* (2016) ǀ Andrade *et al.* (2016)	?	+	-	+/I	I	-
CSPP	Dummy equal to 1 if the bond was issued during the European Corporate Sector Purchase Programme (from March 10, 2016 to the final date of our study December 31, 2016) and zero otherwise.	ECB (2016) ǀ Abidi *et al.* (2017)	?	?	?	-/I	+	+/I
Financial crisis	Dummy that takes the value 1 if the issue date belongs to the 2007-2008 financial crisis (from September 15, 2008 through April 23, 2010) and 0 otherwise.	Gerlach *et al.* (2010) ǀ Beirne *et al.* (2011) ǀ Schuller (2013)	+	+	+	-/I	+	+/I

Sovereign crisis	Dummy that takes the value 1 if the issue date belongs to the European sovereign debt crisis from after April 24, 2010 and 0 before that date.	Beirne *et al.* (2011) | Schuller (2013) | Szczerbowicz (2015) | Gürtler and Neelmeier (2016)	+	+	+	-/I	+/I	?

Table 10: Definition of variables, expected sign and findings

Note: The following characters mean: I = insignificant impact on the credit spread.
? = sign cannot be clearly determined
- = negative impacts on the credit spread.
+ = positive impact on the credit spread.
NA = information about this variable is not available.

8.2. Attachment 2 – Glossary

- ABS - Asset-backed Securities
- ABSPP - Assets-backed Securities Purchase Programme
- ARMA - Autoregressive Moving Average
- AS - Asset Securitization Bonds
- BoE - Bank of England
- BoJ - Bank of Japan
- CB - Covered Bonds
- CBPP - Covered Bond Purchase Programme
- CSPP - Corporate Sector Purchase Programme
- CDO - Collateralized Debt Obligation
- CDS - Credit Default Swap
- CPI - Consumer Price Index
- EAPP - Expanded Asset Purchase Programme
- ECB - European Central Bank
- EONIA - European OverNight Index Average
- EU - European Union
- Fed - Federal Reserve
- FHLMC - Federal Home Loan Mortgage Corporation
- FNMA - Federal National Mortgage Association
- FRFA - Fixed-rate Full Allotment Procedure
- GNMA - Government National Mortgage Association
- LSAP - Large-scale Asset Purchases
- LTRO - Long-term Refinancing Operations

- MBS - Mortgage-backed Securities
- OMT - Outright Monetary Transactions
- PSPP - Public Sector Purchase Programme
- QE - Quantitative Easing
- SB - Sovereign Bonds
- SMP - Securities Markets Programme
- SPV - Special Purpose Vehicle
- TLTRO - Targeted Longer-term Refinancing Operations
- VAR - Vector Autoregression
- VIX - Volatility Index